

ROMAN PORTABLE SUNDIALS

The Empire in Your Hand



RICHARD J. A. TALBERT

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and admiration to the successive directors
of the Ancient World Mapping Center*

*Tom Elliott
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Elizabeth Robinson
Brian Turner
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and to all who have advanced the work of the Center

Preface and Acknowledgments

Students of microhistory are keenly aware that even the smallest of objects may illuminate a society's culture and mindset in quite unexpected and rewarding ways. Paul Zanker's explanation of his carefully considered use of the term *visual imagery* in *The Power of Images in the Age of Augustus* resonates in this connection: "it reflects," he says, "a society's inner life and gives insight into people's values and imagination that often cannot be apprehended in literary sources."¹ My book has a comparable preoccupation with recovering unspoken values and imagination. It weaves together two previously unconnected strands.

On the one hand, it extends intersecting lines of inquiry that I have been pursuing for the past twenty-five years or so. The journey began at the end of the 1980s, when I embraced an extraordinary opportunity to take the lead in designing and publishing comprehensive large-format maps representing the natural and manmade landscape of the Greek and Roman world according to modern cartographic norms and current scholarship. The *Barrington Atlas* (*BAtlas*), an international collaborative work published in 2000, was the product of this initiative and the first major classical atlas to be completed since the 1870s; I reflect on it in *Cartographic Perspectives* 46 (2003). Its approach to visualizing antiquity sharpened my related concern to probe how contemporaries, Romans especially, had comprehended their world by the use of both maps and other means. My principal contribution to understanding Roman cartography has been to reexamine the so-called Peutinger Map—a study published in 2010—and above

1. Paul Zanker, *The Power of Images in the Age of Augustus* (1988), 3.

all to envisage a physical and cultural context for the original production of this astonishing, elongated representation of the world as the Romans knew it.

In this study I diverged from the long-established consideration of the map in isolation and with primarily modern interests in mind. Such a broader approach to Roman cartography, once adopted, soon reinforces the impressions that frustratingly few Roman maps survive, that use of maps was in any case by no means widespread in Roman society, and that the empire's inhabitants also conceptualized their surroundings near and far in a variety of alternative ways. Accordingly I have joined the growing community of colleagues intent on identifying and analyzing these overlooked and revealing glimpses of ancient world-views. The potential of this ongoing quest is far from exhausted. The insistence on sensitivity to contemporary circumstances and thought-patterns articulated in the 1980s by Brian Harley and David Woodward as a guiding principle for their transformative *History of Cartography* project has been a constant source of inspiration. So, too, has Patrick Gautier Dalché's masterly application of the principle to the medieval period, with outstanding results now synthesized by him and collaborators in *La Terre: Connaissance, représentations, mesure au Moyen Âge* (2013), which forms part of the series *L'Atelier du médiéviste*.

On the other hand, my book also aims to make a useful contribution to the long history of sundials by drawing attention to a group of them—largely ignored, if not unknown—that may in a word be described as Roman. Moreover, the interest I develop here consciously focuses not on the timekeeping of these instruments in the customary one-dimensional way, but rather on the intellectual and social environment that they reflect—an anonymous space though this must be, because no designer or owner of any such sundial can as yet be named. Having ventured to dip into the unfamiliar and recondite area of scholarship on sundials (where, I hasten to stress, the experts have extended a most supportive welcome), I can only endorse regretfully the concerns expressed by two leaders in the field that still seem valid today. Thirty years ago Anthony Turner declared:²

The literature of dialling is vast. But it is a literature for the most part technical or archaeological. We are rich in treatises on how to make and use sun-dials, and well supplied with catalogues of surviving examples in public or private collections. But in historical analysis of this material we are poor in the extreme.

2. A. J. Turner, "Sun-dials: History and Classification," *History of Science* 27 (1989): 303–18 at 303 (published version of a conference paper delivered in 1985). On the literature produced between the late fifteenth and early twentieth centuries (with the repetitive nature of its content and presentation stressed), see further Hester Higton, *Sundials at Greenwich: A Catalogue of the Sundials, Nocturnals and Horary Quadrants in the National Maritime Museum, Greenwich* (2002), 25–38, the principal subject of an important review essay by D. A. King, "Towards a History from Antiquity to the Renaissance of Sundials and Other Instruments for Reckoning Time by the Sun and Stars," *Annals of Science* 61 (2004): 375–88.

In a lecture delivered in 2008 Jim Bennett restated the point:

Dialling is too often seen as an isolated discipline with its own self-contained narrative—an “internalist” narrative, in the old jargon of the history of science. It needs to be connected to history.³

My book is an attempt therefore—albeit a modest and limited one—to forge this connection and to investigate at least some of the aspects to which Turner immediately drew attention as in need of inquiry:

When it comes to such questions as who used dials and for what purpose; why they were erected in societies which otherwise showed scant interest in time-measurement; by what criteria of accuracy they should be judged; who made them and how; what was their cost; the source of the materials used in them; and what they imply about the societies that financed and erected them, answers are rarely to be found.

If memory serves, my initial impetus stemmed from the sight of Figure 13.4 (p. 215) in Harley and Woodward's volume 1 *Cartography in Prehistoric, Ancient, and Medieval Europe and the Mediterranean* about ten years ago. Within this figure the reverse of the Oxford portable sundial is shown (Fig. 2.25 below), with the Latin names and associated latitude figures of thirty locations across the Roman empire clearly visible on it. Since I had had frequent recourse to the volume ever since its publication in 1987, it embarrasses me in retrospect not to have grasped sooner that the sundial's reverse furnishes an inviting source for insight into contemporary worldviews. The fact is, however, that only around 2004 did I tentatively form this perception and then begin inquiries with a view to developing it. My first finding was one of surprise and disappointment that the author of the chapter in which the figure features, Oswald Dilke, omitted to offer any discussion of it beyond provision of one tangential footnote (p. 214 n. 9). Near the beginning and end of the following chapter, in which itineraries form a primary focus, Dilke does make two summary claims: first, that itineraries “together with the portable sundial provid[ed] a principal aid to the well-informed traveler” (235); and second, that “Ptolemy's *Geography*, with its tables of coordinates, was never intended for the traveler; but there is reason to think that the latitudes of Roman provinces on the reverse of portable sundials were indebted to Ptolemy, and these sundials were used by travelers and surveyors” (254). Even so, for whatever reason, Dilke never elaborates on either claim or supplies a further footnote, though he might fairly have pointed (as I was to

3. Jim Bennett, “Sundials and the Rise and Decline of Cosmography in the Long Sixteenth Century,” *Bulletin of the Scientific Instrument Society* 101 (2009): 4–9 at 9.

discover) to his own brief discussion (70–73) in his earlier book *The Roman Land Surveyors* (1971).

Telling the time, however, is the focus of this 1971 discussion by Dilke. As I have come to learn, the level of scientific and mathematical acumen that discussions by him and many other experts typically reflect is impressive, but the geographical aspect is consistently overlooked in favor of the chronometric. In favoring the former, I have naturally nonetheless sought to appreciate the latter as fundamental, and am much indebted to Alexander Jones at the Institute for the Study of the Ancient World, New York University, for his unfailingly shrewd, informed guidance on the doubts and difficulties all too often encountered in trying to understand the workings of sundials.

Predictably enough, it has emerged in the course of these investigations that the portable sundials on which geographical locations—and, usually, their latitudes—are recorded have experienced the mixed fortunes repeatedly suffered over the centuries by material objects recovered from antiquity. It is rare for all the components of a Roman portable sundial to survive largely intact, as in the case of the Oxford sundial and, evidently, two others now lost; rather, incompleteness and more-or-less damaged condition are to be expected. In addition, several of these sundials have been random finds, with no known findspot. The first publication of one occurred in the mid-eighteenth century, but then no others were published until the second half of the nineteenth century. Both at that period and subsequently, unfortunate shortcomings occurred in the quality of the record made and in the accompanying drawings or photographs. In a distressing number of instances, there is now no remedy because the sundial has since been mislaid or stolen, and can no longer be traced—a loss that may all too easily occur, given the small size and appealing character of these objects. They were not adequately recognized as a distinct type until 1969, when Derek de Solla Price took the vital step of assembling and discussing them as such in an important article.

Even so, both the sundials themselves and the publications in which further discoveries were recorded have inevitably remained very scattered, hindering the development of a fully informed overview. It is only realistic to suspect that more such objects have already been recovered, and that either they are in unpublished private collections or lie unrecognized in museum storerooms. Two instances of faulty recognition will emerge below (relating to the Este cylinder sundial and a marble fragment from Aquincum). I thank my Chapel Hill colleague George Houston for alerting me to the Vignacourt/Berteaucourt-les-Dames sundial (no. 13 below)—first published most obscurely in 1985—and Pierre Moret for his invaluable assistance in the subsequent search to locate its whereabouts. In the same vein, it was Jonathan Edmondson who first drew my attention to the Mérida sundial (no. 14) by chance, and later photographed it for me. Likewise Christine Hoët-van Cauwenberghe—encouraged by Patrick Gautier Dalché to attend a seminar of mine chaired by him at the Ecole Pratique des

Hautes Etudes, Paris—brought to my notice both the Balkans sundial (no. 16) and the cylinder sundial excavated at Amiens, France, in 2006 (Figs. 1.5 and 1.6). Her excellent initiatives, undertaken with a team of expert collaborators, in mounting the exhibition *Le Temps des Romains: Perception, Mesure et Instruments* at the Musée de Picardie, Amiens (Oct. 27, 2012–Mar. 24, 2013), and in editing the dedicated issue *Le Temps chez les Romains* of *Dossiers d'Archéologie* (2012), have bestowed lasting benefit by drawing attention to the range and importance of sundials in the Roman world. Similarly valuable are the full catalog and synthesis by Eva Winter, *Zeitzeichen: Zur Entwicklung und Verwendung antiker Zeitmesser* (2 vols., 2013), and the monograph *La mesure du temps dans l'Antiquité* by Jérôme Bonnin (2015). It is no less important to acknowledge that my work has been immensely assisted by the provision at long last of up-to-date scholarly editions of Ptolemy's *Geography* by Alfred Stückelberger, Gerd Grasshoff, and collaborators as recently as 2006, and of Ptolemy's *Table of Important Cities* by Stückelberger, Lutz Koch, and Florian Mittenhuber in 2009.

As some balance to setbacks in the past, recent developments in technology have served to advance our understanding dramatically. Discovery of the Balkans sundial (no. 16) may well be due to the use (for better or worse) of a metal detector. No less remarkably, application of reflectance transformation imaging (RTI) has now made it possible to read with considerable confidence a substantial number of names on the Vienna and British Museum sundials (nos. 5 and 15) that proved irrecoverable by conventional means. I am most grateful to George Bevan, Michael Fergusson, and Daryn Lehoux for their expertise in applying RTI and in interpreting the results; also to curators Louise Devoy (British Museum, London, UK), Annamária Facsády (Aquincumi Múzeum, Budapest, Hungary), and Georg Plattner (Kunsthistorisches Museum, Vienna, Austria) for permitting RTI images to be made. It was Daryn Lehoux who kindly alerted me to the “Aquincum Fragment” in Budapest (discussed in the Appendix) after it had by chance been mentioned to him by Tracey Rihll.

For the opportunity to inspect items at first hand, I thank Georg Plattner and Karoline Zhuber-Okrog (Kunsthistorisches Museum, Vienna, no. 5), Stephen Johnston (Museum of the History of Science, Oxford, no. 7), Rory Cook (Science Museum, London, no. 12), Noel Maheo (Musée de Picardie, Amiens, no. 13), Trinidad Nogales Basarrate and Rafael Sabio (Museo Nacional de Arte Romano, Mérida, Spain, no. 14), Silke Ackermann (British Museum, London, no. 15), and Orsolya Láng (Aquincumi Múzeum, Budapest, Aquincum Fragment). I am equally grateful to Alexandr Podossinov and Alexander Sokolicek for commissioning searches of sundials that cannot (yet) be found again unfortunately (nos. 3 and 8 respectively). Many other colleagues merit warm thanks for their generous advice, guidance, and encouragement at various stages of research inevitably interrupted by pressure of competing commitments. These colleagues include Jérôme Bonnin, John Davis, Raymond Davis, Judith Field, Klaus Geus, Elizabeth Greene, Robert Hannah, Kenneth Harl, Derek Keene, David

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At the Ancient World Mapping Center in Chapel Hill (awmc.unc.edu), Ross Twele made the maps with exemplary skill and patience, and Raymond Belanger and Gabriel Moss drafted many figures likewise; in addition, Gabriel rendered vital assistance in the final stages of preparing all the book's maps and figures for delivery to the Press. Jeffrey Becker, Sabrina Cheung, Elizabeth Robinson, and Brian Turner helped in other ways. The lists and tables are all my own compilations. Kevin Wilkinson encouraged me to prepare a draft of Map 4.2 and kindly commented on it. Hilary Becker, Sarah Bond, Lee Brice, and Georgia Tsouvala proved tireless in the quest to secure photographs and permissions. I cannot speak highly enough of the outstanding library resources on the University of North Carolina's Chapel Hill campus, not only in the main (Davis) library, where I am especially indebted to Sellers Lawrence and Tommy Nixon, but also in the Art (Sloane), Science (Kenan), and School of Information and Library Science libraries.

In the course of the book's gradual evolution, I have benefited especially from collaborations with Kurt Raaflaub and many colleagues at Brown University, as well as with others who joined me in offering the Sixteenth Kenneth Nebenzahl, Jr., Lectures in the History of Cartography at the Newberry Library, Chicago. Also formative and deeply appreciated have been periods of research and teaching spent at the Ecole Pratique des Hautes Etudes, Paris, on the joint invitation of Patrick Gautier Dalché and Jean-Louis Ferrary, and at the Université de Reims on the invitation of Didier Marcotte. More generally, the reactions of listeners and participants at many lectures and seminars I have been invited to give worldwide about aspects of this study provided constant stimulus. I heartily thank these audiences, as well as all the institutions and individuals who have granted permission for images to be reproduced. It was on the day following one such seminar for graduate students at the University of Wisconsin, Madison, that Adrienne Hagen proposed a reading of the reverse of the Oxford sundial (no. 7), which I find wholly novel (even though this sundial has been known for more than a century), persuasive, and revealing. She has kindly permitted her proposal to be taken into account here and built on with due acknowledgment; I am especially indebted to her sharp eye and keen insight.

This book-length study supersedes my preliminary observations ventured briefly in chapters of larger scope contributed to *Viajes y Visiones del Mundo* (2008) and to *Geography and Ethnography: Perceptions of the World in Pre-Modern Societies* (2010). With the ability to base its findings on a very much more thorough appraisal, the book now revises and expands the geographical and cultural thrust of those earlier observations. In particular, the number and variety

of sundials that may be taken into account has grown surprisingly—just as the paper by Anthony Turner quoted above expressed hope would happen.⁴ Both the descriptions of them all offered here and the pictorial record (a struggle to assemble) are more complete than any published to date. The descriptions benefit from the miracle that almost every geographical name and associated latitude figure can now be read; all have been checked with care, and apparent slips in previous readings identified. Maps, a Gazetteer, and a Table of Latitudes and Locations are associated analytical tools also presented for the first time. The descriptions make up the second of the book's five chapters. Before it, in the first chapter, sundials generally within the Roman empire, the thinking behind them, and the workings of portable ones are introduced. The third chapter seeks to probe the geographical awareness and worldviews that the sundials described reflect. The fourth chapter pursues intellectual and social approaches, considering the individuals who might design or commission or purchase such a sundial—with what knowledge, how acquired, and with what range of purposes in mind? A final chapter briefly considers postclassical sundials and related objects that may be seen to reflect—independently, it seems—characteristics comparable to those identified in the portable ones of the Roman period studied here. The Appendix on the Aquincum Fragment reinterprets a piece of marble inscribed on both sides as part of a Roman sundial-maker's manual.

My hope is that the book will both enlighten and intrigue readers across disciplines by uncovering a fresh, imaginative vision of the world shared by what might be termed a loose community of Romans. This latitudinal vision springs from minuscule source material unique in character and hitherto noticed by only a few chronometric specialists. It may surprise others at first encounter, yet closer engagement can relate it rewardingly to the wider environment of its period and even beyond. As will become all too apparent, pursuit of this engagement repeatedly creates opportunities to develop themes further and to veer off on tangents. Such temptations I have been determined to resist, though with regret, in the interests of keeping the book focused, concise, and accessible. If it can lay a foundation that stimulates others to investigate further, so much the better.

The support of my wife, Zandra, and family has been unfailing as always. My editor, Stefan Vranka, has long since overcome the bemused skepticism he understandably expressed when the topic of portable sundials was first broached; the sympathetic concern that he and his Press colleagues have shown for the book's design and presentation is warmly appreciated. Because it has proven an expensive work to prepare, the University of North Carolina's financial support has been invaluable. Finally, readers acquainted with the Chapel

4. Turner (1989), 311.

Hill campus, where I teach, will relish the irony that one of its conspicuous landmarks—just to the north of the Morehead Planetarium—is an *immense fixed* sundial with a bronze shadow caster 7 meters long and 4.27 high, constructed in 1956.⁵

Chapel Hill, North Carolina
December 2015

5. Dial 101 in the North American Sundial Society's Registry (sundials.org). See also W. S. Powell (ed.), *Encyclopedia of North Carolina* (Chapel Hill: University of North Carolina Press, 2006), s.v. Sundials.

Contents

Figures and Maps xvii

Abbreviations xxiii

1. Sundials and Their Place in the Roman Empire 3
 1. Sundial Environment 4
 2. Sundial Thinking 6
 3. Portable Sundials: Types and Functioning 9
2. The Geographical Portable Sundials Illustrated and Described 19
 - Presentation Format 19
 1. Rome, no. 1 24
 2. Kircher Museum, Rome, no. 2 27
 3. Memphis, no. 3 29
 4. Aquileia, no. 4 35
 5. Kunsthistorisches Museum, Vienna/Wien, no. 5 36
 6. Crêt-Châtelard, no. 6 48
 7. Museum of the History of Science, Oxford, no. 7 52
 8. Aphrodisias, no. 8 60
 9. Samos, no. 9 65
 10. Time Museum, no. 10 70
 11. Philippi, no. 11 76
 12. Science Museum, London, no. 12 82
 13. Vignacourt/Berteaucourt-les-Dames, no. 13 88
 14. Mérida, no. 14 93

15. British Museum, London, no. 15	99
16. Balkans, no. 16	104
3. Geographical Awareness and Worldviews	III
1. Names	III
2. Figures: The Concept of Latitude	116
3. Figures: The Concept of Latitude Applied	119
4. Distinguishing Homonymous Cities	123
5. Comparative Frameworks and Orientation	126
6. Latitude and Worldview	129
4. A Community of Dialers?	137
1. Time Telling: Margins of Error	141
Table: Time Museum, no. 10, and British Museum, London, no. 15	145
2. Criteria for the Choice of Names	147
3. The Appeal of the Object	153
4. The Spreading of Knowledge and Related Attractions	155
5. Time-Telling Needs	163
6. Conclusion: A Community of Dialers?	167
5. Post-classical Comparisons	171
1. The Astrolabe	173
2. The <i>Navicula</i> and “Regiomontanus” Types	177
3. Nuremberg Sundials	181
4. Scottish Stone Sundials	184
5. The Twentieth Century and Beyond	186
Appendix: The Aquincum Fragment: A Sundial Maker’s Manual?	191
Gazetteer	203
Table of Latitudes and Locations	213
Bibliography	221
Ancient and Medieval Texts and Inscriptions	221
Modern Scholarship	222
Index	231

Figures and Maps

Figures

- I.1 Monumental sundial erected at Aphrodisias in the early third century CE. 6
- I.2A Glass flask illustrating memorable features of Puteoli. 7
- I.2B Memorable features of Puteoli engraved on the glass flask (drawing). 7
- I.3 Cylinder sundial found in a late-first-century CE tomb near Este, Italy. 10
- I.4 Functioning of the Este cylinder sundial (drawing). 11
- I.5 Cylinder sundial excavated at Samarobriva (modern Amiens, France) in 2006. 12
- I.6 Samarobriva cylinder sundial (drawing): lettering and line work for months and hours. 12
- I.7 Functioning of a pillbox sundial (drawing). 13
- I.8 Pillbox sundial, supposedly found on Mont Hérapel near Forbach on the border between France and Germany. 14
- I.9 Oxford sundial, no. 7: obverse, comprising inner and outer discs, with hour scale and shadow caster. 15
- I.10A Components of the Oxford sundial: outer disc (obverse). 16
- I.10B Components of the Oxford sundial: inner disc (obverse); bolt straddled by the hour scale and shadow caster; pin. 17
- 2.1 Rome, no. 1: drawing by Gianfrancesco Baldini. 25
- 2.2 Kircher Museum, no. 2: lid obverse. 28
- 2.3 Kircher Museum: box obverse. 29

- 2.4 Memphis, no. 3: obverse drawing by Constantin von Tischendorf. 31
- 2.5 Memphis: reverse drawing by Constantin von Tischendorf. 33
- 2.6 Aquileia, no. 4: sketch by Friedrich Kenner (redrawn). 35
- 2.7 Vienna, no. 5: top obverse. 37
- 2.8 Vienna: top reverse. 37
- 2.9 Vienna: bottom reverse. 38
- 2.10 Vienna: bottom obverse with post. 39
- 2.11 Vienna: bottom obverse with "hand" and wedge. 40
- 2.12 Vienna: disc 1 obverse. 41
- 2.13 Vienna: disc 1 reverse. 42
- 2.14 Vienna: partial reconstruction of disc 1 reverse. 42
- 2.15 Vienna: disc 2 obverse. 43
- 2.16 Vienna: disc 2 reverse. 43
- 2.17 Vienna: disc 3 obverse. 44
- 2.18 Vienna: partial reconstruction of disc 3 obverse. 44
- 2.19 Vienna: disc 3 reverse. 45
- 2.20 Vienna: disc 4 obverse. 45
- 2.21 Vienna: disc 4 reverse. 46
- 2.22 Vienna: partial reconstruction of disc 4 reverse. 46
- 2.23 Crêt-Châtelard, no. 6: drawing by Vincent Durand. 50
- 2.24 Oxford, no. 7: obverse. 53
- 2.25 Oxford: reverse. 54
- 2.26 Oxford: reconstruction of the original reverse. 56
- 2.27 Aphrodisias, no. 8: obverse. 60
- 2.28 Aphrodisias: obverse drawing. 61
- 2.29 Aphrodisias: reverse. 63
- 2.30 Aphrodisias: reverse drawing. 63
- 2.31 Samos, no. 9: obverse. 65
- 2.32 Samos: obverse drawing. 66
- 2.33 Samos: reverse drawing. 67
- 2.34 Samos: reverse. 68
- 2.35 Time Museum, no. 10 (front, left), and the four bronze instruments
discovered with it. 71
- 2.36 Time Museum: obverse. 71
- 2.37 Time Museum: reverse drawing. 72
- 2.38 Time Museum: reverse. 74
- 2.39 Philippi, no. 11: open position. 76
- 2.40 Philippi: open position drawing. 77
- 2.41 Philippi: closed position. 78
- 2.42 Philippi: closed position drawing. 78
- 2.43 Philippi: Alexandria quadrant. 79
- 2.44 Philippi: Rhodes quadrant. 79

- 2.45 Philippi: Rome quadrant. 79
- 2.46 Philippi: Vienne quadrant. 79
- 2.47 Science Museum, no. 12: disc obverse. 82
- 2.48 Science Museum: reconstruction by the Science Museum. 83
- 2.49 Science Museum: suspension arm and ring. 83
- 2.50 Science Museum: disc obverse drawing. 84
- 2.51 Vignacourt/Berteaucourt-les-Dames, no. 13: obverse. 88
- 2.52 Vignacourt/Berteaucourt-les-Dames: obverse drawing. 89
- 2.53 Vignacourt/Berteaucourt-les-Dames: reverse. 89
- 2.54 Vignacourt/Berteaucourt-les-Dames: reverse drawing. 90
- 2.55 Mérida, no. 14: reverse overview 93
- 2.56 Mérida: reverse drawing. 94
- 2.57 Mérida: Alexandria to Sarmatia. 95
- 2.58 Mérida: Moesia to Tarraco. 95
- 2.59 Mérida: Tarraco to Pannonia Inferior. 96
- 2.60 Mérida: Pannonia Inferior and Pannonia Superior. 96
- 2.61 Mérida: Raetia to Dacia. 97
- 2.62 Mérida: Belgica to Britannia Inferior. 97
- 2.63 British Museum, no. 15: obverse with the upper end of the suspension arm and the ring. 100
- 2.64 British Museum: reverse with the suspension arm and the ring. 103
- 2.65 Balkans, no. 16: reverse drawing 105
- 2.66 Balkans: obverse. 106
- 2.67 Balkans: obverse drawing. 106
- 2.68 Balkans: reverse. 107
- 2.69 Balkans: reconstruction of reverse and arm drawing. 107
- 3.1 Peutinger Map. 127
- 3.2 “Anglo-Saxon” or “Cotton” world map. 128
- 4.1 Inscription recording the dedication of a temple in Apulum, Dacia, by a legiary *horologiaris* (drawing). 140
- 4.2 Vignacourt/Berteaucourt-les-Dames, no. 13: reconstruction of the reverse. 155
- 4.3 “Ilam Pan,” unearthed in the Midlands of England in 2003. 161
- 5.1A Recessed base (“mater”) of the sole surviving astrolabe inscribed in Greek, with the open-work star map (“rete”) and the plate (“tympnum”) marked for the Hellespont both inserted. 175
- 5.1B Plate (“tympnum”) marked for the Hellespont, a component of the sole surviving astrolabe inscribed in Greek. 176
- 5.2 Recessed base (“mater”) of the sole surviving astrolabe produced before around 1100 that includes a gazetteer (in Arabic). 177
- 5.3A Greenwich *navicula* portable sundial: front. 178
- 5.3B Greenwich *navicula* portable sundial: back. 179

- 5.4 Design for an adjustable portable sundial sketched and published by Johannes Müller (Regiomontanus) in 1474. 180
- 5.5 Gilt-brass Regiomontanus sundial produced by Johannes Krabbe at Minden, Germany, in 1584. 181
- 5.6 Ivory diptych sundial produced by Paul Reinmann at Nuremberg, Germany, in 1607. 183
- 5.7A Cantray sundial, Scotland: “front.” 184
- 5.7B Cantray sundial: “back.” 185
- 5.8A Ansonia Sunwatch dial plate. 187
- 5.8B Ansonia Sunwatch name list (Atlanta to Wichita). 188
- 5.9 Richard Mille 58-01 Tourbillon World Timer Jean Todt limited edition, 2015. 189
- 5.10 Jacob & Co. Diamond Bezel Five Time Zone Watch (JC47YB). 190
- A.1 Aquincum Fragment, Side A: RTI image. 193
- A.2 Side A: RTI image with specular enhancement. 194
- A.3 Side A: line work drawing. 195
- A.4 Side A: specular enhanced zoom. 196
- A.5 Side B: RTI image. 197
- A.6 Side B: RTI image with specular enhancement. 197
- A.7 Side B: line work drawing. 198
- A.8 Line work drawing of side A, with line work drawing of side B superimposed in reverse. 200

Maps

- 2.1 Rome, no. 1. 26
- 2.2 Memphis, no. 3. 34
- 2.3 Vienna, no. 5. 47
- 2.4 Crêt-Châtelard, no. 6. 49
- 2.5 Oxford, no. 7. 58
- 2.6 Aphrodisias, no. 8. 64
- 2.7 Samos, no. 9. 69
- 2.8 Time Museum, no. 10. 75
- 2.9 Philippi, no. 11. 80
- 2.10 Science Museum, no. 12. 86
- 2.11 Vignacourt/Berteaucourt-les-Dames, no. 13. 92
- 2.12 Mérida, no. 14. 98
- 2.13 British Museum, no. 15. 102
- 2.14 Balkans, no. 16. 108
- 3.1 Provinces of the Roman Empire around 200 CE. 115
- 3.2 Samos, no. 9, with tour route outlined. 134
- 3.3 Aphrodisias, no. 8, with tour route outlined. 135

- 4.1 Findspots of sundials. 138
- 4.2 Aurelius Gaius' circuit of the Roman empire. 162
- G.1 Locations on sundials inscribed in Greek. 205
- G.2 Locations on sundials inscribed in Latin. 206
- G.3 Locations on all sundials covered by Maps G.1 and G.2. 207

Abbreviations

AE	<i>L'Année Epigraphique</i>
AJP	<i>American Journal of Philology</i>
BAtlas	R. J. A. Talbert (ed.), <i>Barrington Atlas of the Greek and Roman World and Map-by-Map Directory</i> (Princeton: Princeton University Press, 2000 [print]; app for iPad, 2013)
BNP	<i>Brill's New Pauly</i>
CAH ²	<i>Cambridge Ancient History</i> (2nd ed.)
CIL	<i>Corpus Inscriptionum Latinarum</i>
CRAI	<i>Comptes Rendus des séances de l'Académie des Inscriptions et Belles-Lettres</i> (Paris)
GLM	Alexander Riese (ed.), <i>Geographi Latini Minores</i> (Heilbronn: Henninger, 1878)
IG	<i>Inscriptiones Graecae</i>
IK	<i>Inschriften griechischer Städte aus Kleinasien</i>
ILS	<i>Inscriptiones Latinae Selectae</i>
OCD ⁴	<i>Oxford Classical Dictionary</i> (4th ed.)
PBA	<i>Proceedings of the British Academy</i>
PIR ²	<i>Prosopographia Imperii Romani</i> (2nd ed.)
PLRE	A. H. M. Jones et al. (eds.), <i>The Prosopography of the Later Roman Empire</i> , vol. 1 AD 260–395 (Cambridge: Cambridge University Press, 1971)
RIC	<i>Roman Imperial Coinage</i>
ZPE	<i>Zeitschrift für Papyrologie und Epigraphik</i>

Roman Portable Sundials

I

Sundials and Their Place in the Roman Empire

Because this book's subject is in fact just *one* type of *portable* sundial in the Roman empire, at first glance it could well seem an absurdly narrow project. It is fair to say that ancient sundials are altogether little known, portable ones still less so, and this unique type of the latter in effect not at all. Moreover, a perusal of modern scholarship soon strengthens the predictable impression that sundials at any stage of classical antiquity (or later) have seldom attracted much interest for purposes beyond comprehending their operation and gauging the precision of their timekeeping.¹ Anybody willing to continue reading this introductory chapter could therefore reasonably anticipate a technical study with just this focus, lacking appeal beyond the limited circle of chronometric specialists.

To all who already feel deterred, however, let me at once offer encouragement by declaring such a pessimistic expectation mistaken. Mine is a cultural study, emphatically not a technical one. Only quite recently was it realized that the individual sundials that are the book's subject *do* together constitute a distinct type—a surprisingly uniform one in key respects—and that they preserve a remarkable store of detailed geographical information. Moreover, from such information it is possible to outline the geographical grasp of the makers and users of this type of sundial, and thus to gain at least a glimpse of their “world-view,” the overall perspective from which they visualize and interpret their surroundings. Hence the book aims to contribute especially to the ongoing advancement of a newfound appreciation of “informal

1. See, for example, Karlheinz Schaldach, *Römische Sonnenuhren: Eine Einführung in die antike Gnomonik* (3rd ed., 2001); and in greater depth Eva Winter, *Zeitzeichen: Zur Entwicklung und Verwendung antiker Zeitmesser* (2 vols., 2013), with the review by Karlheinz Schaldach, *Gnomon* 87.2 (2015): 144–49. Note further Denis Savoie, *Recherches sur les cadrans solaires* (2014), 17–51 (with scant concern for the limitations of the latitude data, on the Oxford sundial especially).

geography,” the elusive and varying spatial *mentalités* that inhabitants of the Roman empire somehow acquired and carried in their heads. This is a large, challenging, and important topic. During recent years, scholars have skillfully elucidated tantalizing insights into Roman worldviews from an extraordinary range of source materials not yet exploited for the purpose.² This book aims to extend that quest, and in so doing to recover something of the broad intellectual and social contexts within which the sundials it investigates were made and used. In other words, in its scope the book even ranges beyond geography and timekeeping to tap into the values, preoccupations, and imagination of at least part of Roman society empirewide. The prospect that such tiny instruments can prove so revealing may seem farfetched, but it is nonetheless realistic; we truly can recover something of the mentalities that they reflect.

1. Sundial Environment

Any educated persons today who could magically return to experience for themselves life in Rome’s vast empire during the second century CE (see Map 3.1)—its most prolonged spell of peace and prosperity—would soon become conscious of three broad features that underpin the present study. First, those among the empire’s sixty million or so inhabitants who might be termed educated by the standards of the period—a limited elite among the population, though not tiny in number³—shared two principal languages, Latin and (in the East) Greek, which were both spoken and written. Second, this elite also shared a deeply embedded traditional concern to calculate, record, and control time—both longer-term (days, months, years, even centuries), and shorter-term (divisions of day and night, especially hours). Even so, they never developed genuinely practical instruments that could take measurements with precision (of distance in particular). A mix of custom and Roman authority had resulted in empirewide adoption of the “Julian” calendar (instituted at Rome from 45 BCE)⁴ and other shared conventions for timekeeping, although this standardization had not

2. See, for example, Benet Salway, “Putting the World in Order: Mapping in Roman Texts,” in R. J. A. Talbert (ed.), *Ancient Perspectives: Maps and Their Place in Mesopotamia, Egypt, Greece, and Rome* (2012), 193–234; and, with impressive scope, Klaus Geus and Martin Thiering (eds.), *Features of Common Sense Geography: Implicit Knowledge Structures in Ancient Geographical Texts* (2014).

3. On the challenges of determining levels of literacy see, in brief, *OCD*⁴ s.v. literacy (by Rosalind Thomas).

4. For reflections on this calendar and its impact, see, for example, Denis Feeney, *Caesar’s Calendar: Ancient Time and the Beginnings of History* (2007); more briefly, id., “Time and Calendar,” in Alessandro Barchiesi and Walter Scheidel (eds.), *The Oxford Handbook of Roman Studies* (2010), 882–94.

necessarily led to abandonment of alternative, regional practices derived from other, non-Roman cultures (Egyptian, for example); both the standard Roman practices and others could be maintained concurrently.⁵ Third, instruments that recorded shorter-term time (divisions of the day in particular) were a common sight in both public and private places, most obviously in the cities of an empire that was quite urbanized by premodern standards, notably so in the East.⁶

Various devices—lamps that burned a specific amount of oil, for example, or containers (Greek κλεψύδρα, Latin *clepsydra*) into which or from which water flowed—were in use for marking defined intervals of time.⁷ The most typical timekeeping devices, however, were sundials, usually termed ὥρολόγιον in Greek, *horologium* or *solarium* (also *horarium*) in Latin.⁸ The vast majority were fixed stone objects, not portable. They were designed in a range of sizes and shapes—spherical, conical, and planar being the most common—and installed in, or close to, such prominent public locations as a marketplace (agora/forum), shrine, bath, gymnasium, or theater, as well as in private houses and even tombs.⁹ The credit for installing a sundial in a public place is regularly claimed by one or more magistrates, for example, or priest, or private benefactor.¹⁰ Their timekeeping function aside,¹¹ most such sundials were decorative, and some of them even monumental, such as that erected at Aphrodisias in honor of the emperor Caracalla and his mother Julia Domna early in the third century CE (Fig. 1.1).¹² We learn from an inscription that the important Italian port Puteoli boasted a sundial originally funded by an emperor and at some later date repaired at the city's expense.¹³ It is tempting to imagine that this was the

5. Note in this connection Sacha Stern, *Calendars in Antiquity: Empires, States, and Societies* (2012), especially 299–353. For a concise overview, see Leofranc Holford-Strevens, *The History of Time: A Very Short Introduction* (2005), especially 31–33, 91–96.

6. Overviews in Winter (2013), 185–232; Jérôme Bonnin, *La mesure du temps dans l'Antiquité* (2015), 229–50.

7. Lamps: Robert Hannah, *Time in Antiquity* (2009), 96–97. *Clepsydrae*: Bonnin (2015), 87–98.

8. The Greek and Latin terms are usefully reviewed by Bonnin (2015), 73–87.

9. Winter's catalog (2013, vol. 2, 251–617) includes a detailed record of about 400 such sundials known from throughout classical antiquity, a marked advance on the 256 listed by Sharon Gibbs, *Greek and Roman Sundials* (1976). Bonnin (2015), 11 and 387–401 claims to have identified about 600. See further repository.edition-topoi.org/collection/BSDP

10. For such inscriptions on these sundials, see Winter (2013), 173–77.

11. On fixed sundials in general, note G. W. Houston, “Using Sundials,” in L. L. Brice and Daniëlle Slootjes (eds.), *Aspects of Ancient Institutions and Geography: Studies in Honor of Richard J. A. Talbert* (2015), 298–313.

12. Hannah (2009), 88–90; Winter (2013), 268–69.

13. *CIL* X.1617; Winter (2013), 509.



FIGURE 1.1 Monumental sundial erected at Aphrodisias in the early third century CE, now in the courtyard of the Selçuk Museum, Turkey. Diameter 1.18 m.

Photo: Carole Raddato.

sundial (near a stadium?) apparently referred to among the city's memorable features, and perhaps even pictured, on one of the glass flasks (several are known) produced as souvenirs for tourists and other admirers (Figs. 1.2A, 1.2B).¹⁴

2. Sundial Thinking

The thinking behind the general design of sundials in the Roman world was evidently transmitted from classical Greece, but cannot be attributed more

14. Altogether three of the flasks mention a *solarium*, but on only one does it seem to be illustrated. Discussion by S. E. Ostrow, "The Topography of Puteoli and Baiae on the Eight Glass Flasks," *Puteoli* 3 (1979): 77–137 at 94, 121–22 (a ninth such flask has since come to light, but does not refer to this feature: *AE* 2005.763a–c). See more generally Ernst Künzl and Gerhard Koeppel, *Souvenirs und Devotionalien: Zeugnisse des geschäftlichen, religiösen und kulturellen Tourismus im antiken Römerreich* (2002), 25–27; and Bonnin (2015), 78, 81–82, 245. To be sure, the authorities at Puteoli use the term *horologium* in the inscription, while all three flasks use *solarium*, which may equally refer to a terrace; even so, these concerns do not suffice to rule out the identification conjectured.



FIGURE I.2A Well-preserved glass flask illustrating memorable features of the Italian port city Puteoli. It was manufactured in the third or fourth century CE perhaps, and was supposedly found in North Africa. Full height 15.1 cm, maximum diameter 10 cm. Now in the World of Glass museum, St. Helens, UK (inv. no. SAHGM 1974.002). The self-standing T-shaped feature below the AR of STADIVSOLAR seems likely to be a conspicuous (fixed) sundial (*solarium*), perhaps near a stadium.

Photo: Pilkington Glass Collection, The World of Glass, and Nicola Bibby.

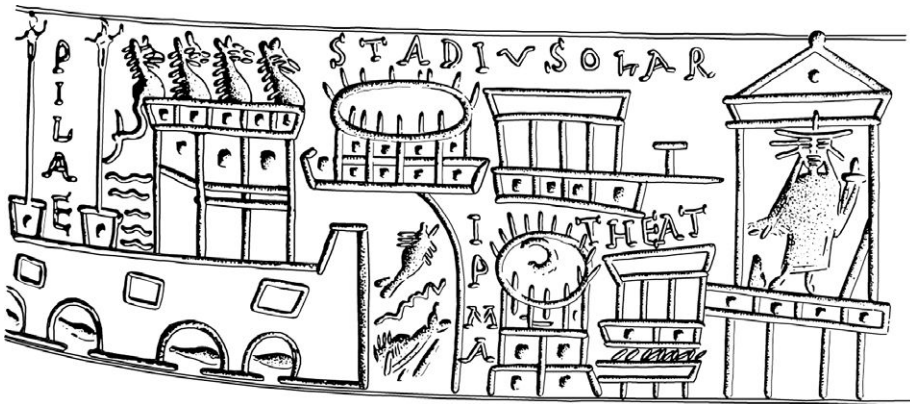


FIGURE I.2B Memorable features of Puteoli engraved on the glass flask.

Ancient World Mapping Center after P. Compton in K. S. Painter, "Roman Flasks with Scenes of Baiae and Puteoli," *Journal of Glass Studies* 17 (1975): 54–67, fig. 13.

specifically. This thinking is both simple and sophisticated.¹⁵ Its simple concept is the realization that the shadow cast by a rod (Greek *gnomon*) onto a semicircular or semispherical surface sectioned off with lines can record successive divisions of the day as the sun seems to pass overhead from dawn to dusk. Considerably more sophisticated is the related realization that a sundial works accurately only if its design and installation take into account where exactly on the earth's curved surface it is to be located. In other words, attention to what both postclassical Greeks and we still today term latitude (see further section 3 below) is essential to ensure a sundial's accurate operation. This said, the installation of fixed sundials in the Roman world did not in fact invariably reflect the exact latitude of the location; precision was in any event hard to attain. In such instances, moreover, it emerges that users were not necessarily dissatisfied, nor even aware of the inaccuracy. For most practical purposes, the difference between the latitude for which a fixed sundial was designed and the location where it was installed would have to be substantial before it became really noticeable. It was certainly not regular practice to inscribe on a sundial the location or latitude for which it had been designed.

The sections into which Greeks and Romans by convention divided the period of daylight for timekeeping were the Babylonian ones of twelve "hours," with sunrise marking the start of the first hour and noon occurring at the start of the sixth hour. It is essential to keep in mind that most timekeeping devices in the Roman empire did *not* record "equinoctial" hours of fixed, equal length, which is the type of hour in common use today. To be sure, a *clepsydra* (above) was designed to record a fixed period of time, but even so—as in the case of most other measures too—among the empire's communities there was never a standard definition for the length of an hour, let alone subdivisions of it.¹⁶ The hours that Roman sundials typically recorded were merely twelve equal divisions of the period of daylight—a period that varied in length according to the latitude where the sundial was installed and the time of year, hence the term "seasonal" hours (in contrast to equinoctial ones of fixed length).

Strictly speaking, daylight varies in length at every location every day, and so correspondingly do the twelve seasonal hours into which the sundials divide it. In practice, of course, the differences are not likely to be detected within short periods or across short distances; but over an extended period or considerable distance they are unmistakable. At Rome, for example, in the course of

15. See, for example, James Evans, *The History and Practice of Ancient Astronomy* (1998), 129–39; Hannah (2009), 68–144; and, in brief, id., "Timekeeping," in J. P. Oleson (ed.), *The Oxford Handbook of Engineering and Technology in the Classical World* (2008), 740–58.

16. For practical purposes, a half-hour seems to be the minimum span of time by which contemporaries reckoned. Notably, the same could be remarked of country districts in continental Europe even in the late nineteenth century; see Vanessa Ogle, *The Global Transformation of Time 1870–1950* (2015), 68.

a year daylight diminishes to as little as just over nine (fixed, modern) hours at the winter solstice (December 21–22 in our calendar, the day when the tilt of the earth is most inclined away from the sun in the northern hemisphere), and grows to as much as about fifteen and one-quarter hours at the summer solstice (June 20–21, when the tilt there is most inclined toward the sun).¹⁷ This difference becomes increasingly more extreme at locations further north. Thus at Rome one of the twelve (seasonal) hours in the day could be as short as three-quarters of a (fixed, modern) hour, or as long as one and one-quarter (fixed, modern) hours, according to the time of year.

3. Portable Sundials: Types and Functioning

Undoubtedly well before the first century BCE there was recognition that sundials did not have to be fixed objects, and that portable ones could also be produced. At the end of his summary list of many types of sundial and their supposed inventors, the Roman architectural writer Vitruvius (late first century BCE) includes specific mention of the portable type, though without naming any inventor:

Item ex his generibus viatoria pensilia uti fierent, plures scripta reliquerunt.¹⁸

Again, several [sc. experts] have left writings about ones derived from these types [just mentioned] for taking on a journey and hanging up.

Earlier in his list Vitruvius mentions separately a πρὸς πᾶν κλίμα (Greek “for every zone/latitude”) type, the invention of which he attributes to Theodosius and Andrias, the latter not otherwise known, the former presumably the notable Bithynian mathematician active in the second or first century BCE.¹⁹ No doubt this type, too, was by definition intended to be portable.

These fleeting references are unique in surviving literature, and the extensive writings that Vitruvius has in mind are all lost. If nothing else, it is striking that he evidently considers portable sundials to be unexceptional rather than recent novelties or matter for special comment. There is no knowing how he would assign the surviving examples among his categories.²⁰ A considerable

17. For the progression in Rome over a year at five-day intervals, see R. J. A. Talbert, *The Senate of Imperial Rome* (1984), 501–3.

18. *De Architectura* 9.8.1, ed. Pierre Gros et al. (1997).

19. See P. T. Keyser and G. L. Irby-Massie (eds.), *The Encyclopedia of Ancient Natural Scientists: The Greek Tradition and Its Many Heirs* (2008), ss. vv.

20. Jean Soubiran, in his Budé text of the sentence quoted above (Vitruve, *De l'architecture*, livre IX, 1969), inserts a comma between *viatoria* and *pensilia* in the belief that Vitruvius is



FIGURE 1.3 Cylinder sundial found in the late-first-century CE tomb of an oculist near Este, Italy; now in the Museo Nazionale Atestino di Este.

Photo: Museo Nazionale Atestino di Este.

variety of designs survives, not all of them needing to be suspended. Two designs merit immediate notice.

The first of these two designs—intended (like a fixed sundial) for use within a single (unspecified) latitude—could be either self-standing or suspended to function, and has a neatly compact cylindrical or “pillar” shape; in a relatively uncomplicated way it embodies the principles developed further in more versatile portable sundials. Two Roman examples of this design are known, both made of bone. The better preserved of the two is now in the Museo Nazionale Atestino, Este. It was discovered in 1884 near this town in northern Italy among the objects in the well-preserved late-first-century CE tomb of an oculist (Fig. 1.3).²¹ The latitude (45) for which it was made is reckoned to be more or

referring to two distinct types of sundial rather than just one (so translate “for taking on a journey or hanging up”); see his commentary, pp. 254–56, 266–70. The possibility cannot be ruled out, but—as Bonnin (2015), 127 concludes (cf. 112)—no such clear distinction can be made among surviving sundials.

21. See Simonetta Bonomi, “Medici in Este romana 2: La tomba del medico,” *Aquileia Nostra* 55 (1984): cols. 77–108, esp. 82 (object no. 29), 87–90; further discussion by Mario Arnaldi

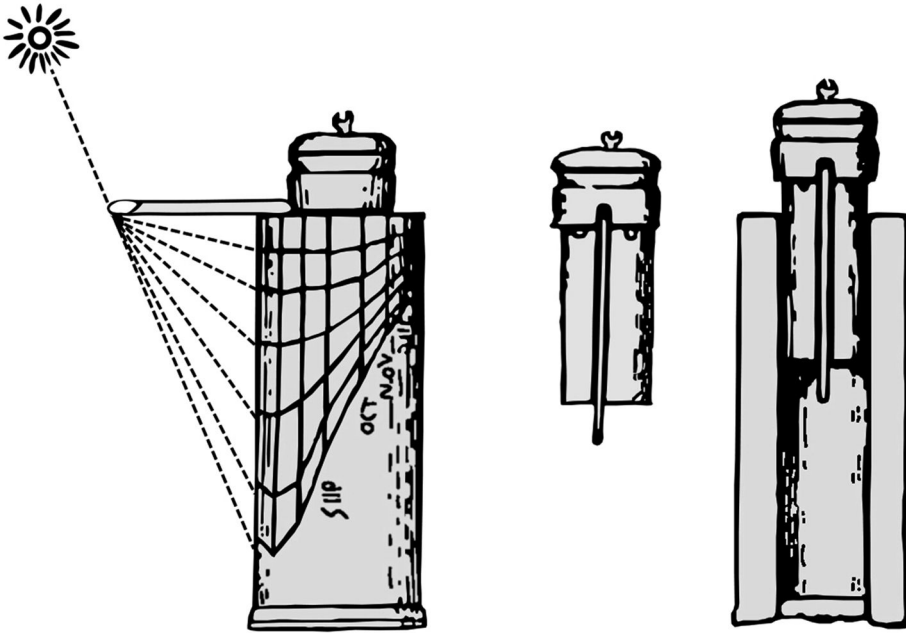


FIGURE 1.4 Functioning of the Este cylinder sundial.

Ancient World Mapping Center.

less that of the region in which it was found. A “stopper”—into which two bronze shadow-caster rods (*gnomons*) are fitted on either side—can be raised with the help of a ring, and the appropriate shadow caster is then extended to line up with the month at the moment of use (the longer of the two shadow casters for winter months, the shorter for summer). A network of lines for the months (named in Latin) of the Julian calendar and six seasonal hours is inscribed along the outside of the cylinder (Fig. 1.4). As is typical for portable sundials, users noting the hour marked by the shadow caster must be alert to whether they are checking before midday (when the sun is highest in the sky), or after it, because the same network serves both the first six-hour period and (in reverse order) the second such period in the twelve-hour day. Correct identification of this object as a sundial—not made until 1984, a full century after its discovery—was a surprise. It overturned the presumption that this type was invented during the Middle Ages rather than centuries earlier during antiquity.²²

The other ancient example of the same design emerged in 2006 during excavations of a burial area on the outskirts of Roman Samarobriua (modern Amiens, France), and has been dated to the first half of the third century CE

and Karlheinz Schaldach, “A Roman Cylinder Dial: Witness to a Forgotten Tradition,” *Journal for the History of Astronomy* 28 (1997): 107–17; Winter (2013), 290 (Ateste no. 1).

22. See further Chapter 5.

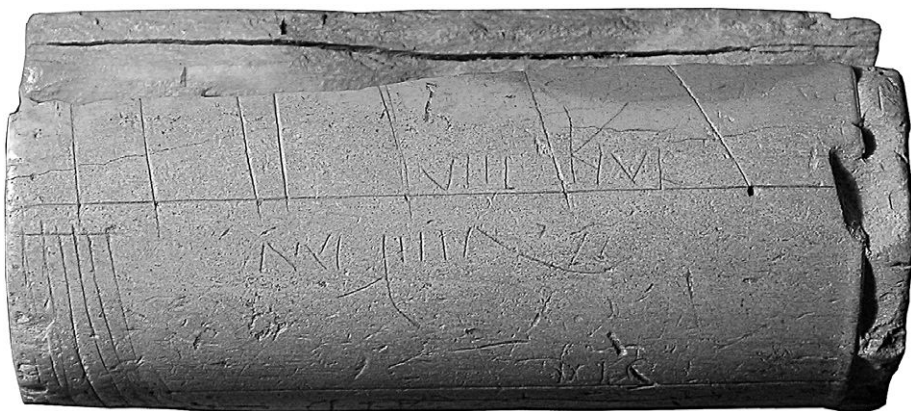


FIGURE 1.5 Cylinder sundial excavated at Samarobriva (modern Amiens, France) in 2006. Note VIII KIVL (“8 days before the Kalends of July,” the summer solstice) clearly visible near the middle toward the right. Now in the Musée de Picardie, Amiens.

Photo: INRAP Nord-Picardie, and Stéphane Lancelot.

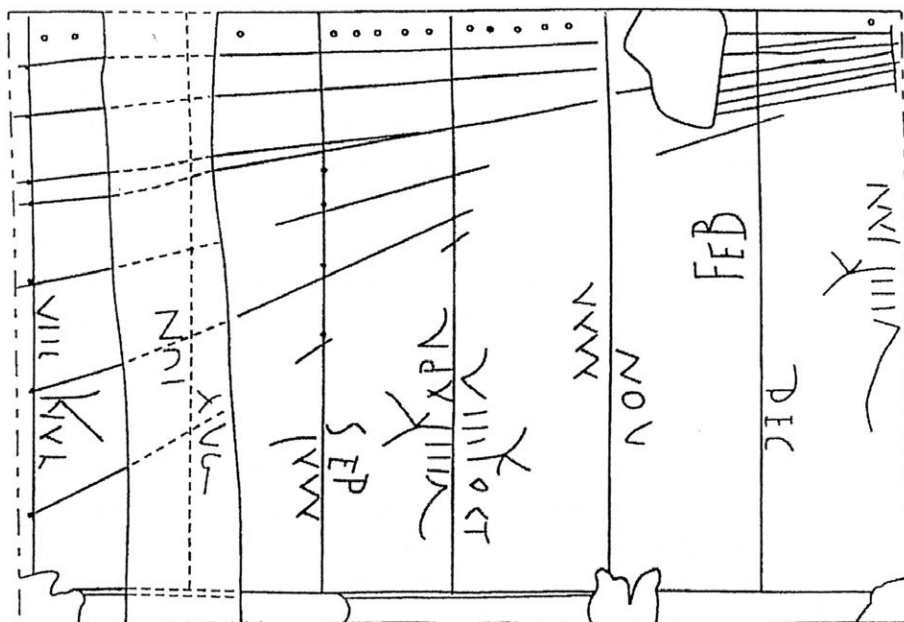


FIGURE 1.6 Samarobriva cylinder sundial: lettering and line work for months and hours. VIII KIVL is clearly visible at the far left.

Christine Hoët-van Cauwenbergh and Éric Binet in *Cahiers du Centre Gustave Glotz* 19 (2008): 117, fig. 4a.

(Fig. 1.5).²³ Its cylinder—now in the Musée de Picardie, Amiens—happens to be approximately the same height as the Este example (6.2 cm; diameter 2.95), and it too seems to have been made for use around the latitude (50) at which it was found (Fig. 1.6). The cylinder is the only component of the Samarobriva sundial to have survived.

The second of the designs meriting immediate notice is a bronze “pillbox” type. It stands on a surface rather than being suspended. Rays of the sun passing through a small hole in the side then fall onto a “hand” (as of a clock) and a network of lines inside to mark the hour (Fig. 1.7). Examples of this type are known made for a single latitude, with or without any location specified.²⁴ The example in the latter category shown here is reported as found near Forbach in northeastern France during the nineteenth century; its diameter is 4.9 cm,

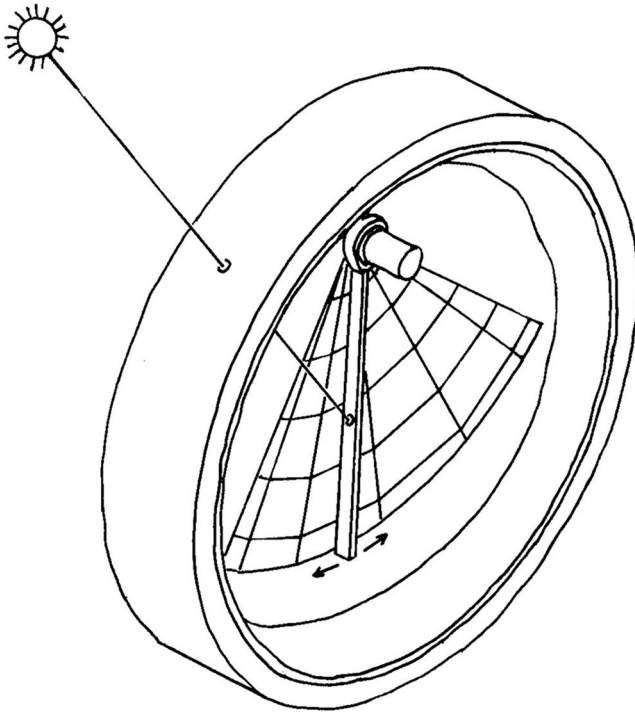


FIGURE 1.7 Functioning of a pillbox sundial.

Paolo Auber in *Bulletin of the British Sundial Society* 16 (2004): 128, fig. 10.

23. See Christine Hoët-van Cauwenberghe, Éric Binet, and Annick Thuet, “Cadran solaire sur os à Amiens (Samarobriva),” *Cahiers du Centre Gustave Glotz* 19 (2008): 111–27; Éric Binet, “Le cadran solaire portable d’Amiens: Circonstances d’une découverte exceptionnelle,” *Dossiers d’Archéologie* 354 (2012): 34–39; and further Chapter 4.

24. With a location specified: see no. 2 (Kircher Museum) in Chapter 2.



FIGURE 1.8 Pillbox sundial, supposedly found during the nineteenth century on Mont Hérapel near Forbach on the border between France and Germany; diameter 4.9 cm. Now in the Musée de La Cour d'Or, Metz, France.

Photo: Musée de La Cour d'Or, Metz, and Laurianne Kieffer.

and depth 1.2 cm (Fig. 1.8).²⁵ Two other examples offer greater versatility because they incorporate loose discs with locations inscribed on them, which may be inserted or removed in accordance with the user's whereabouts at different latitudes. These two examples are therefore to be grouped with the bronze sundials that form the main subject of this book, and consequently merit inclusion in Chapter 2.²⁶

Most surviving Roman portable sundials are of a further type that *does* need to be suspended in order to function. The names of locations—each usually with its latitude figure—are to be found inscribed on fourteen of these sundials. Chapter 2 is devoted to illustrating and describing them all, together with the two examples just mentioned. To outline in the first instance the principal characteristics and operation of the fourteen, it is most useful to refer to

25. Winter 2013, 425 (Metz no. 1), with A. Schlieben, "Römische Reiseuhren," *Annalen des Vereins für Nassauische Alterthumskunde und Geschichtsforschung* 23 (1891): 115–28 at 116–18; cf. Winter (2013), 602–3 (Fundort unbekannt, nos. 8, 9).

26. No. 5 (Vienna/Wien) in particular; also no. 4 (Aquileia).

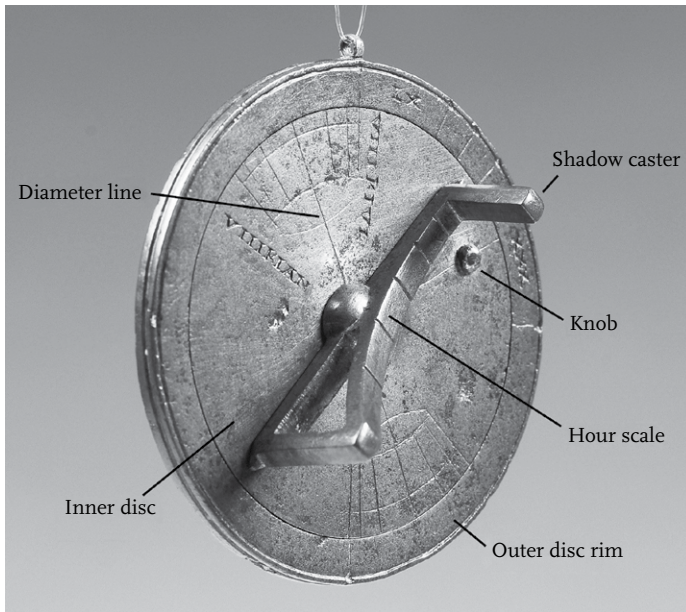


FIGURE 1.9 Oxford sundial, no. 7: obverse, comprising inner and outer discs, with hour scale and shadow caster.

Photo: Museum of the History of Science, University of Oxford, with author's labeling added.

sundial no. 7 in Chapter 2. All its components are preserved (Fig. 1.9). Its *obverse* (or top or front) comprises an outer disc (Fig. 1.10A) and an inner one shaped to sit within the outer one's rim (Fig. 1.10B). This pair of discs is held together by a bolt, which the *hour scale and shadow caster* (a single component) straddles (Fig. 1.10B). The bolt is inserted through the hole at the center of both discs; below the *reverse* or underside of the outer disc, a pin passes through a hole in the bolt to secure the inner disc in place.

For a user to determine the time of day accurately, the sun must of course be shining. In addition, a user first needs to know as precisely as possible the latitude at which he or she is situated *and* which day of the year it is, because his position in relation to the sun varies according to both, wherever he may be. For the day, if he does not already know it (or the month at least), he must make inquiries. The same applies to the latitude, although he can be conveniently informed at once if he is aware of being in (or near) one of the provinces or regions or cities listed with its latitude on the reverse of the sundial's outer disc (see Fig. 2.25). Once he knows the latitude, he rotates the inner disc on the obverse with the aid of the *knob* there, so that the radius line that runs through the knob meets the relevant latitude as marked on the *rim of the outer disc*. Here, a succession of four equally spaced short lines is inscribed, with the Latin figures XXX and LX beyond each end counterclockwise. These figures signify latitudes 30 and 60 respectively, and thus the two intermediate lines mark latitudes 40

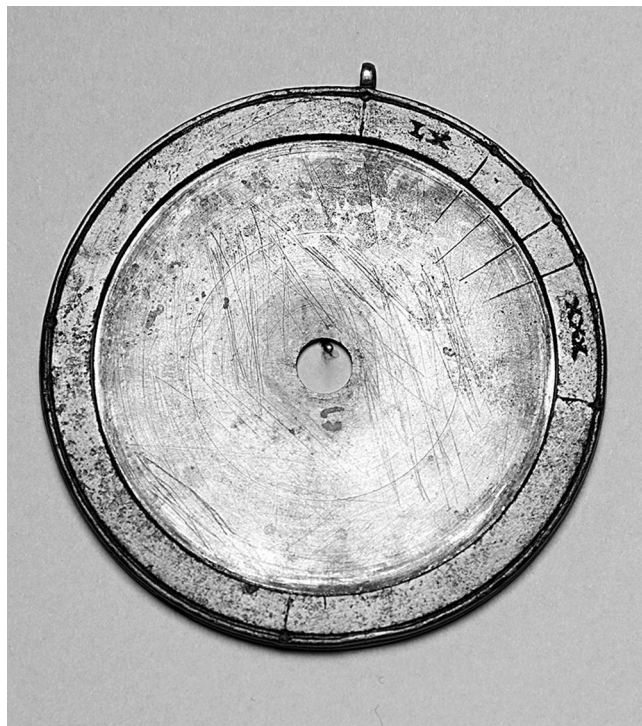


FIGURE 1.10A Components of the Oxford sundial: outer disc (obverse).

Photo: Museum of the History of Science, University of Oxford.

and 50. In addition, the figure XXX is placed equidistant between the latitude 30 line and another line beyond (for latitude zero); LX is placed likewise, equidistant between the latitude 60 line and another line beyond (for latitude 90). On this sundial no further lines are inscribed on the rim of the outer disc, so a user who wishes to rotate the inner disc to, say, latitude 44 is left to estimate just where it occurs between the lines for 40 and 50.

For a user to set the sundial for the day of the year on which it is to be used according to the sun's declination—the angular distance of the sun north of the equator, which varies with the seasons according to the earth's rotation—another straight line forms a *diameter* on the inner disc. This diameter marks the equinoxes (when the sun has zero declination), although there is no notation to that effect. At each end of this diameter line an identical fan-shaped network of lines is drawn. At one end (only) the network is framed by the Latin abbreviations VIIIKIVL (*VIII Kal Iul* = June 24 in the Julian calendar) in one direction, and VIIIKIAN (*VIII Kal Ian* = December 25) in the other, the summer and winter solstices respectively. At both ends the network includes two subdivider lines inscribed on either side to distinguish the passage of time between solstice and equinox according to the sun's declination; thus each subdivision

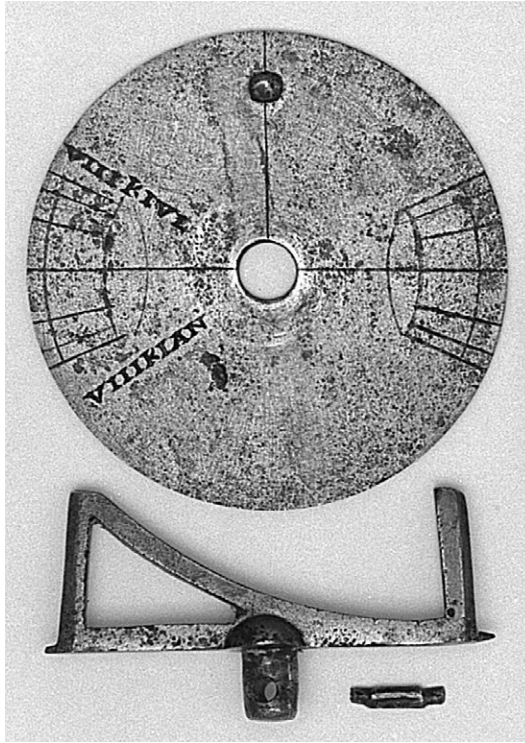


FIGURE I.IOB Components of the Oxford sundial: inner disc (obverse); bolt straddled by the hour scale and shadow caster; pin, which passes through the hole in the bolt to keep the inner disc in place.

Photo: Museum of the History of Science, University of Oxford.

created in this way spans one month (none of them named on this sundial). So—with all these indicators understood—it is to the relevant date here that the user turns the pointer below the *shadow caster* (*gnomon*), again needing to estimate for lack of more defined divisions.

With the requisite latitude and day of the year now both set, the user must next suspend the sundial by passing a thread through the ring attached to the outer disc. The user then turns the suspended sundial until its position causes the upright shadow caster to throw a shadow directly along the hour scale, which rises in an arc away from it. Five divisions are marked along this hour scale (at successive 15° intervals), making it possible to distinguish six hours. Before noon, the second hour begins when the shadow has retreated to the division on the hour scale furthest from the shadow caster, and so on until at noon (the sixth hour) there is no longer shadow at all along the hour scale. Thereafter, through the twelfth hour, which ends at sunset, the progress of the seventh to twelfth hours is shown in reverse by the movement of the shadow along the hour scale away from the shadow caster.

A considerable range of departures from this outline in one respect or other will emerge in Chapter 2. Even so, the fourteen comparable sundials described there are all fundamentally similar to no. 7 in their characteristics and operation. Two points in conclusion: first, analysis of various issues arising from the outline is held over until Chapters 3 and 4. Second, it is important to keep in mind that the names and figures listed on the reverse of the sundial, as in the case of no. 7, do not regulate its functioning. Rather, they serve merely as an optional aid: users remain free to set the sundial to any latitude within the range marked.

2

The Geographical Portable Sundials Illustrated and Described

Proceeding on from the outline at the end of Chapter 1, this chapter now presents the main subject matter of the book. It illustrates and describes the sixteen portable sundials from the Roman period that I term “geographical,” that is, on which one or more geographical names (and, usually, related latitude figures) are inscribed for the purpose of assisting users.¹ Readers should not feel obliged to linger over the descriptions at this point. After a preliminary perusal with minimal attention to the details, they may well prefer to proceed at once to Chapter 3 and thereafter revisit the descriptions for closer reference whenever the argument prompts them. Even so, the descriptions are fundamental and merit their prominent position here.

Presentation Format

For this presentation of the sundials, there are two issues to be settled first: nomenclature and order. My solutions are intended as practical above all. Thus the “name” and three-letter abbreviation that I attach to each sundial are chosen with ease of reference in mind: the name relates either to the findspot, or to a museum where the sundial is (or was) to be found. A satisfyingly logical order for the presentation of the sundials is impossible to determine. To order them by findspot (as does Winter 2013) seems not to be particularly meaningful when in several instances there is no record of a findspot, or only a sketchy or unreliable record (see further Map 4.1 below). Equally, to order the

1. Because of its rather different focus and criteria, my grouping cuts across the classification into six types developed by Arnaldi and Schaldach (1997), 108, table 1, and extended by Bonnín (2015), 106–9. For the same reason, it omits certain sundials included in lists such as that offered by Winter (2013), 78–79, for example.

sundials by date is not realistic, when the prospects for dating individual ones at all precisely, let alone in relation to others, are so slim. They vary greatly in their state of preservation and access; the conscientiousness with which they have been published is likewise variable. Several are lost, and others are in private collections. At least there are drawings of all sixteen, but it is disappointing that photographs were never taken of those now lost when (from the late nineteenth century) it would have been feasible to do this.

My decision has been to present, and number, the sixteen sundials in the order of their first publication. This arrangement has the double merit of highlighting the pace at which our knowledge of this type of sundial has grown, while permitting new discoveries to be added without disruption. The descriptions here are deliberately kept concise; analysis and comment on many matters are postponed to subsequent chapters. At the least, one or more photographs illustrate each entry (or a drawing if there is no photograph), in most instances along with a map outlining the locations named on the sundial (explained further below). Although matters of geography are a primary concern in each description, the need for an adequate grasp—but seldom more than that—of how each sundial was designed to tell the time is also recognized as essential. By the same token, the bibliographies appended to each entry aim to record the important items of scholarship on each sundial in order of publication, but they make no claim to be exhaustive. Further reference should be made to the Bibliography (arranged alphabetically) at the end of the book, and also to the Gazetteer, the Table of Latitudes and Locations, and maps throughout.

Use of the still-novel technique of reflectance transformation imaging (RTI) has made it possible to read with confidence the names in two instances² where severe damage to surfaces defeats efforts by conventional means.³ In addition, with use of RTI specular enhanced images can be produced. Specular enhancement within the RTI viewer is a filter that wholly eliminates distracting color and gives a high-contrast rendering of only physical-surface variation. In consequence, any inscribed lettering or line work appears as if it were incised into

2. Nos. 5 (Vienna/Wien) and 15 (British Museum). Note also the Aquincum Fragment (see Appendix) in this connection.

3. The method is summarized by Bevan, Lehoux, and Talbert (2013), 221: “The object of interest is photographed using a standard digital single-lens reflex camera anywhere from 15 to 60 times, with the light placed in a different position along a notional hemisphere for each shot. A black sphere placed adjacent to the object has a highlight cast on its surface by the flash in each instance: a small, bright speck that allows the software to calculate the direction of light for each shot. This data allows the RTI builder to construct a composite image that can be dynamically relighted, and the 3D features of the surface are then enhanced by a number of filters. . . . The combination of relighting, zoom, and filtering in RTI can in many cases render otherwise illegible text partly or wholly legible.”

chrome, and even minute surface details, largely obscured to the naked eye, become visible.

Where (as typically) there is no designated starting point for the geographical names and corresponding latitude figures inscribed on a sundial, for consistency my tables list the names *starting from the name with the lowest latitude figure*, even if there is reason to think that the intended order for reading the names and figures may actually have been different.

In the tables the *first* (furthest left) and *second* columns list names followed by their latitude figure as both appear (in Greek or Latin) on the sundial. A letter that cannot be read with confidence is marked with an *underdot*. A wholly missing letter is marked [.]. For numerals, see further below.

The *third* and *fourth* columns repeat the name (often expanded) in Latin or anglicized form, and the latitude figure (**bolded**) in Arabic numerals with any fraction decimalized. An **asterisk** (*) signifies a figure that *seems likely* to reflect a slip by the engraver.

The *fifth* column records (in Arabic numerals, *italicized*) the latitude figure(s) in degrees and minutes for the location according to Ptolemy's *Geography* (Γεωγραφικὴ Ὑφήγησις, compiled around 150 CE), edited by Alfred Stückelberger, Gerd Grasshoff, and others⁴; a few variant readings in their edition are noted in parentheses.⁵ A single latitude figure is given for a city, and normally two figures (southernmost and northernmost latitudes) for an island or region or Roman province. Two words of caution are called for. First, this style of stating latitude figures partly modernizes Ptolemy's usage. He in fact states a fraction of a degree literally in terms of one or more fractions, *not* on the scale of 60 minutes used here for the convenience of today's reader. Thus in Ptolemy's original Greek 5 minutes is expressed as one-twelfth (the smallest fraction used), 25 minutes as one-third plus one-twelfth, 30 minutes as one-half, 55 minutes as one-half plus one-third plus one-twelfth, and so on.⁶ Second, readers should be aware that either or both of the figures given for the southernmost and northernmost latitudes of an island or province or region may be no more than inferences from the range of figures offered by Ptolemy for features or settlements within it; in the case of Sicily, for example, he offers no figures specifically for the southernmost and northernmost points of the island.

4. Ptolemaios: *Handbuch der Geographie*, 2 vols. (2006).

5. For Ptolemy's aims and methods in this work, see further J. L. Berggren and Alexander Jones, *Ptolemy's Geography: An Annotated Translation of the Theoretical Chapters* (2000), 3–4, and Chapter 3 sections 2–3 below.

6. See the summary by Stückelberger, Grasshoff, et al. (2006), vol. 1, 45, and further Alfred Stückelberger, Lutz Koch, Florian Mittenhuber, et al., (eds.), *Klaudios Ptolemaios Handbuch der Geographie: Ergänzungsband* (2009), 219–22.

The *sixth* (furthest right) column records the *approximate* “correct” latitude(s) in degrees and minutes according to modern calculations (in the case of extensive territory, to the *nearest whole degree* only). A tilde (~) preceding any figure warns that the figure is only very approximate.

Greek and Latin lettering and numerals: in the scripts of both languages letter forms double as numerals. On the geographical portable sundials, the style of the letter forms—whether in words or numerals—is, broadly speaking, uniform and “classical”; the forms seem not to offer clues useful for dating any sundial with confidence or for relating one to another.⁷

Greek numerals: A = 1, B = 2, Γ = 3, Δ = 4, Ε = 5, ς = 6, Ζ = 7, Η = 8, Θ = 9,
 Ι = 10, ΙΑ = 11, ΙΒ = 12, ΙΓ = 13, ΙΔ = 14, ΙΕ = 15, Ις = 16, ΙΖ = 17, ΙΗ = 18,
 ΙΘ = 19, Κ = 20, ΚΑ = 21, et sim. Λ = 30, Μ = 40, Ν = 50, Ξ = 60, Ο = 70,
 Π = 80, Φ = 90.

Fractions (three): < on the Memphis sundial, no. 3, as well as C on the Aphrodisias and (I believe) Samos sundials, nos. 8 and 9, signifies *half* (.5 = 30 minutes). On the Memphis sundial, Ε in the latitude figure for Meroe is presumably a slip introduced at some stage for <, which was widely used. On this sundial, as well as on the Philippi sundial, no. 11, Γ_o following a two-letter numeral signifies *two-thirds* (.66 = 40 minutes; hence the placement of Neapolis between Bostra and Caesarea on the Memphis sundial). On the Aphrodisias and (I believe) Samos sundials, Γ following a two-letter numeral signifies *one-third* (.33 = 20 minutes). Figures to half a degree occur as well on both the Memphis and Aphrodisias sundials, but the former evidently happens to record no figure (or none legible) to one-third, and the latter no figure to two-thirds. Lack of a Greek zero creates uncertainty about the meaning of the figure ΜΓ for Thessalonica on the Aphrodisias sundial. It has been read as 43 (the same latitude for the city that the Memphis sundial records), but possibly 40.33 is meant (a more accurate figure, recorded by other sundials; see Gazetteer).⁸ Typically, three (Γ) would be distinguished from one-third by an acute accent following the letter in the latter instance (Γ'). At first glance, the Γ in the figure for Thessalonica on the Aphrodisias sundial appears to be followed by such an accent, but in fact all the straight strokes of the letters on this sundial are capped

7. This difficulty recurs across the extraordinary range of inscribed objects in the Roman world that is loosely termed *instrumentum domesticum*; see in general A. E. Cooley, *The Cambridge Manual of Latin Epigraphy* (2012), 185, 423. The range, and the challenges it presents, are impressively illustrated by M. E. Fuchs, Richard Sylvestre, and Christophe Schmidt Heidenreich (eds.), *Inscriptions mineures: Nouveautés et réflexions* (2012).

8. In principle the same doubt might also be raised about the figure ΜΓ for Thessalonica, Edessa, and Constantinople on the Memphis sundial, for which only Constantin von Tischendorf's drawing is available; but his alertness to other fractions here makes it reasonable to assume that he would have noted an accent following the Γ in any of these instances.

by a stub resembling an accent, and nothing further is inscribed separately after Thessalonica's ΜΓ. In five instances on the Samos sundial, a fraction is evidently added to the single letter M signifying latitude 40. The symbol for this fraction varies in shape, but its ^ character seems likely to signify Γ (one-third) in contrast to C (one-half), which I discern once on this sundial.⁹

Latin numerals: I = 1, II = 2, III = 3, IIII or IV = 4, V = 5, VI = 6, VII = 7, VIII = 8, VIIII or IX = 9, X = 10, XI = 11, et sim. XX = 20, XXX = 30, XXXX or XL = 40, L = 50, LX = 60, LXX = 70, LXXX = 80, LXXXX = 90.¹⁰

On the Mérida sundial, no. 14, note the untypical usage XXX IIX = 38, XL IIX = 48.

Fraction (one only): S (for *semis*) = half (.5 = 30 minutes).

When there is the option of a shorter or longer form for a Latin numeral, the choice is liable to be arbitrary. Thus on the obverse of the Crêt-Châtelard sundial, no. 6, where space is limited, XXXX is nonetheless used instead of XL, and LXXXX instead of XC. On its reverse, by contrast, the XL form is used for all the “forty” figures (and the XXIIII figure for NASVM IEN may be a slip for XLIIII). There is only a single instance on the Latin sundials where the IX form is preferred to VIIII: PANNON XLIX (Vignacourt, no. 13); it would not have been difficult to fit XLVIIII here instead.

The *maps* (2.1 through 2.14, one for each sundial except nos. 2 Kircher Museum, and 4 Aquileia) are intended as no more than sketches that use a modern physical landscape oriented North to outline the locations named. The frame of each map is set by the range of the locations to be marked, and it in turn determines the (small) scale in each instance. Each name is marked in the Latin or anglicized form used below (all capitals for regions; capital and lower case for cities), followed by the latitude specified for it on the sundial in Arabic numerals. Normally, each name is placed on the map at the latitude specified by the sundial (even when this latitude is inaccurate) *and* at its correct longitude according to modern calculations (no sundial furnishes longitude figures). What can fairly be regarded as the name of a province or region is not accompanied by any shading or line work framing the named area's extent. By contrast, what can fairly be regarded as the name of a city is preceded by:

Solid round symbol if the latitude specified is accurate to half a degree

Hollow square symbol if the latitude specified is inaccurate by more than half a degree but less than one and a half

9. Note that in the inscribed fourth-century tax registers from Aegean islands and western Asia Minor the only symbol used to signify a fraction is < for half. See Peter Thonemann, “Estates and the Land in Late Roman Asia Minor,” *Chiron* 37 (2007): 435–78 at 443.

10. Note that on the Aquincum Fragment XC = 90: see Appendix.

Cross (x) if the latitude specified is inaccurate by one and a half degrees or more

Exception: because the names on sundials nos. 5 Vienna/Wien and 16 Balkans are not accompanied by latitude figures, the maps for these sundials place all names in their approximately correct geographic locations.

In addition, note the three composite maps that accompany the Gazetteer. The first (G.1) marks—in their approximately correct geographic locations—the names on all the maps for the sundials inscribed in Greek; the second (G.2) does the same for all the sundials inscribed in Latin, and the third (G.3) does the same for all sixteen sundials.

All the maps are intended merely as rudimentary aids to today's readers. None is to be regarded as a reliable indicator of how a Roman might have envisaged what is represented there according to modern norms.

1 Rome (Rom)

Lost

Material Bronze

Dimensions Diameter 8.5 cm

Provenance and ownership Supposedly found in the vicinity of Rome about 1740. Gianfrancesco Baldini purchased it from an unnamed seller; its subsequent ownership and whereabouts are unknown.

Description The only description and drawings are by Baldini (1741). See Figure 2.1. The sundial was evidently quite well preserved, except that the upright shadow caster at the end of the hour scale had broken off (compare Crêt-Châtelard, no. 6). The design would appear to comprise outer and inner discs like the Oxford sundial (no. 7). The inner disc is bolted in between the hour scale above it and the outer disc below. With the aid of the knob visible on the **obverse**, the inner disc can be rotated so that the diameter line on which the knob is placed meets the chosen latitude as marked on the rim of the outer disc. Here, fifteen equal subdivisions are inscribed—with the figures XXX and XI (a slip for LX?) at either end, counterclockwise—to mark 2-degree intervals between latitudes 30 and (presumably) 60. For the user to set the sundial for the day of the year required, there is another diameter line, identified on one side (only) by the abbreviation AEQ as marking the equinoxes. A fan-shaped network of lines is inscribed at each end of this line, the network to the right on the drawing being less detailed. Its counterpart to the left is framed at the top by the Latin abbreviation VIII K IVL (*VIII Kal Iul* = June 24), and at the bottom by VIII K IAN (*VIII Kal Ian* = December 25), denoting the summer and

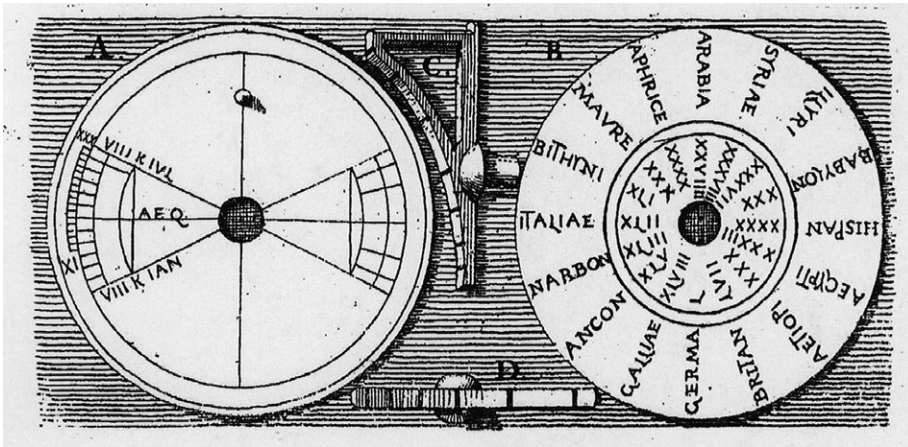


FIGURE 2.I Rome, no. 1: drawing by Gianfrancesco Baldini (1741).

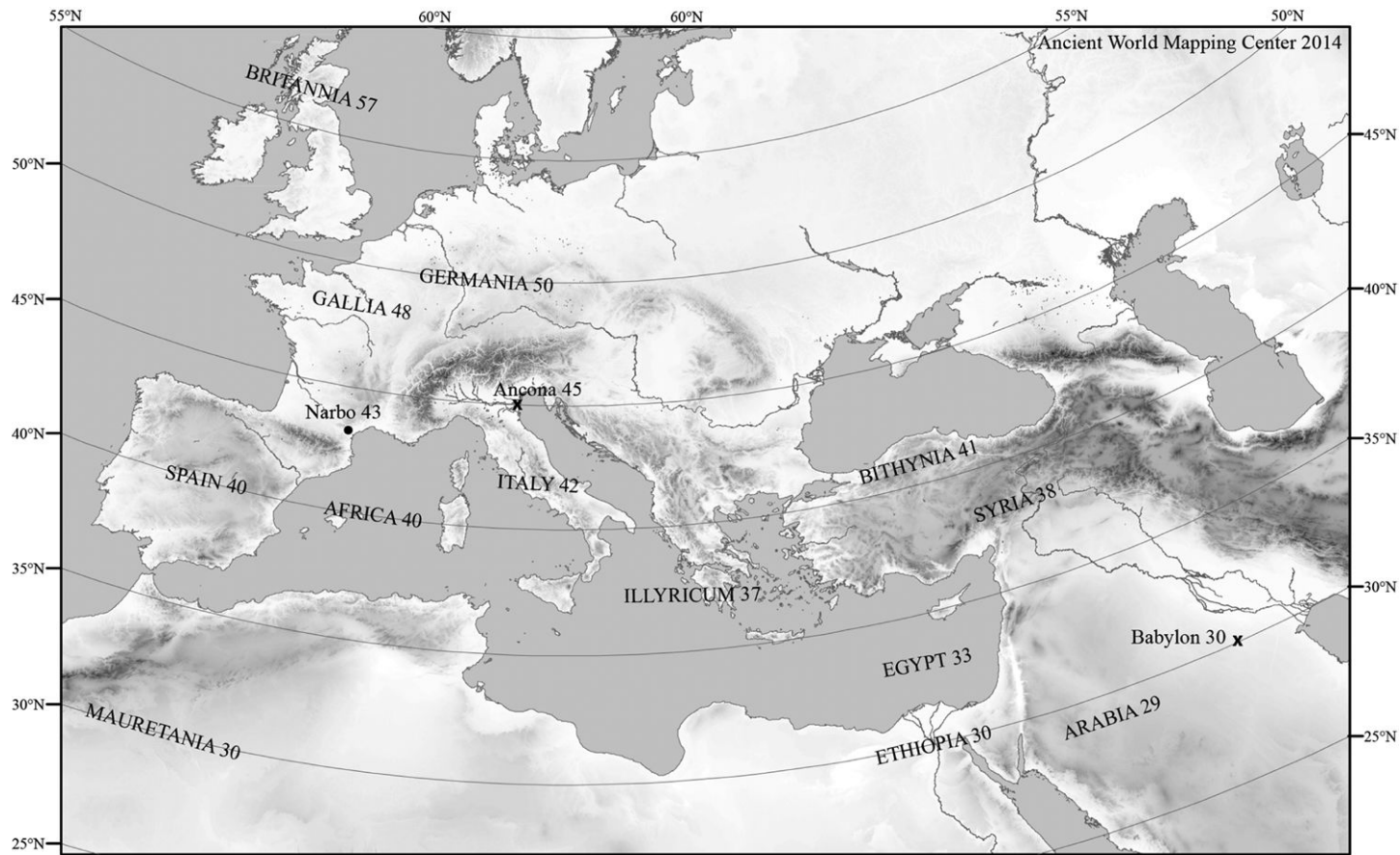
From Baldini's publication.

winter solstices respectively; twelve equal subdivisions are marked in between for the half-year. Six divisions are marked along the hour scale.

On the **reverse**, sixteen names—each starting at the rim—are inscribed in Latin, followed by a latitude figure. See Map 2.I. As on the Mérida sundial (no. 14), a double-line circle separates the names and figures. Although the range of the latitudes marked out on the obverse of the Crêt-Châtelard sundial (no. 6) extends much further, the names and latitude figures on its reverse are altogether similar to those here.

AETHIOPI	XXX	Ethiopia	30	~south-23 50	~south-24
AEGYPTI	XXXIII	Egypt	33	23 50-31 20	~24-31
HISPAN	XXXX	Spain	40	36 00-46 00	~36-44
BABYLON	XXX	Babylon(ia?)	30	35 00	32 40
ILLYRI	XXXVII	Illyricum	37	41 00-45 00	~41-46
SYRIAE	XXXVIII	Syria	38	31 00-38 00	~32-37
ARABIA	XXVIII	Arabia	29	28 30-31 40	~28-33
APHRICE	XXXX	Africa	40	25 00-33 20	~south-37
MAVRE	XXX	Mauretania	30	25 00-36 00	~south-36
BITHYNI	XLI	Bithynia	41	41 15-43 30	~40-42
ITALIAE	XLII	Italy	42	38 00-45 00	~38-46
NARBON	XLIII	Narbon-is/-ensis	43	43 (15)	43 10
ANCON	XLV	Ancona	45	43 40	43 40
GALLIAE	XLVIII	Gallia	48	42 10-53 30	~43-51
GERMA	L	Germania	50	45 30-56 00	~47-54
BRITAN	LVII	Britannia	57	51 30-59 00	~50-59

Dating uncertain



I Rome (Rom)

1:32,500,000

MAP 2.I Rome, no. I.

Ancient World Mapping Center.

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- Gianfrancesco Baldini, “Sopra un’antica piastra di bronzo, che si suppone un’orologio da sole,” *Saggi di dissertazioni accademiche pubblicamente lette nella nobile Accademia Etrusca dell’antichissima città di Cortona* 3 (1741): 185–94.
- D. J. de Solla Price, “Portable Sundials in Antiquity, Including an Account of a New Example from Aphrodisias,” *Centaurus* 14 (1969): 242–66 at 257.
- J. V. Field, “Some Roman and Byzantine Portable Sundials and the London Sundial-calendar,” *History of Technology* 12 (1990): 103–35 at 113–17.
- Winter (2013), 537–38 (Rom no. 17).

2 Kircher Museum, Rome (Kir)

Rome, Museo Nazionale (Palazzo Massimo), inv. no. 65165, formerly Museo Kircheriano

Material Bronze

Dimensions Diameter 5 cm, depth 1.5 cm

Provenance and ownership Nothing is known before a private individual presented the sundial to Rome’s Museo Kircheriano in the mid-nineteenth century. It subsequently came to the Museo Nazionale (Paribeni 1932, 306, no. 1067), and is now displayed in Palazzo Massimo (level –2, room 2).

Description The sundial comprises two pieces, one forming a box and the other its lid; compare no. 5 (Vienna/Wien) below. The earliest published description is unsigned and dates to 1857. The obverse of the **lid** is, or resembles, the obverse of a coin or medallion bearing the head of the emperor Commodus (*PIR*² A 1482) with the legend M COMMODVS ANTONINVS PIVS FELIX AVG BRIT (the first two letters are damaged; Fig. 2.2). This imperial titulature would be valid between 185 CE (when Commodus took the title Felix) and his death at the end of 192. The reverse of the lid is blank. On the obverse of the **box** is inscribed a month and hour scale (with the abbreviated names of the twelve months of the Julian calendar in Latin; Fig. 2.3), together with the name ROMA in Latin at the top; the scale is reckoned to fit Rome’s latitude. Just below the name, there is a “hand” (as of a clock)—possibly no longer its full original length—that could be moved to the appropriate position for casting a shadow over the month in which the sundial is being used. With the box upright, rays of the sun penetrating through a hole in its side make it possible to tell the time (cf. Fig. 1.7). The reverse of the box is blank.

Months (the upper row to be read from right to left):

IVN	MAI	APR	MAR	FEB	IAN
IVL	AVG	SEP	OCT	NOV	DEC

Dating Sometime from the mid-180s CE onward; how far onward is impossible to determine. It is notable that *RIC* 3 (1930) lists no coin of Commodus



FIGURE 2.2 Kircher Museum, no. 2: lid obverse.

Photo: inv. 65165 su concessione del Ministero dei beni e delle attività culturali e del turismo—Soprintendenza Speciale per il Colosseo, il Museo Nazionale Romano e l'Area archeologica di Roma.

that spells out his names and titles so fully. The obverse of the lid is almost certainly a later idiosyncratic imitation, therefore, rather than an issue actually made during the emperor's reign. His coins continued in circulation until the mid-third century at least. The maker of this obverse presumably worked from one or more such coins, deciding to omit the usual *IMP CAES* of the imperial title and to include elements of titulature that typically appear on reverses. Strictly speaking, therefore, Clare Rowan (2009, 4) erred when she included this item in a survey of how coins in the Roman world were removed from circulation and variously reused for nonmonetary purposes.

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- [anon.], "Un orologio solare antico [Appendice di Scienze Naturali, 1]," *La Civiltà Cattolica* ser. III. 6 (Rome, Mar. 28, 1857): 97–101 (with drawings by the distinguished astronomer Pietro A. Secchi).
- CIL* XV Pars 2/1 (1899).7203 with drawing of the obverse of the box.
- Roberto Paribeni, *Le Terme di Diocleziano e il Museo Nazionale Romano* (1932), 306, no. 1067 (no drawing or photograph).



FIGURE 2.3 Kircher Museum: box obverse.

Photo: inv. 65165 su concessione del Ministero dei beni e delle attività culturali e del turismo—Soprintendenza Speciale per il Colosseo, il Museo Nazionale Romano e l'Area archeologica di Roma.

De Solla Price (1969), 248–49 (no drawing or photograph).

Edmund Buchner, “Römische Medaillons als Sonnenuhren,” *Chiron* 6 (1976): 329–48 and Tafel 56–58 at 330 (no drawing or photograph).

Karsten Dahmen, *Untersuchungen zur Form und Funktion kleinformatiger Porträts der römischen Kaiserzeit* (2001), 240 Anh. 19.4.

Clare Rowan, “Slipping out of Circulation: The After-life of Coins in the Roman World,” *Journal of the Numismatic Association of Australia* 20 (2009): 3–14 at 4.

Winter (2013), 536–37 (Rom no. 16).

3 Memphis (Mem)

Lost

Material Bronze

Dimensions Not recorded

Provenance and ownership Random find (disc and shadow caster / hour scale), evidently well preserved, said to have been retrieved from a necropolis at

Memphis, Egypt (*BAtlas* 75 E1). Soon afterward supposedly, it was acquired by Constantin von Tischendorf, no doubt in nearby Cairo, where he spent a considerable time in 1859 (1860, 6–7). He errs in referring to the find as an astrolabe, but admits his inability to secure expert help in understanding it (1860, 73). A century and more later, the shadow caster / hour scale was reported to be in the Hermitage Museum (St. Petersburg, Russia) when de Solla Price made inquiries (1969, 257), but there was no word about the disc. My own recent inquiries have proven fruitless, so both parts must be presumed lost.

Description The only description and drawings are by von Tischendorf, who claims to have reproduced the style of the Greek lettering with care (1860, 73 and Plate II). Be that as it may, the description is no more than a brief appendage to the catalog of codices, manuscripts, and *antiquitates variae* acquired by him in the East during 1859 (1860, 47–73). Along part of the **obverse** rim, latitude figures up to 90 are marked off and numbered in Greek figures every 6 degrees clockwise, with 2-degree intervals also being marked up to 24 (Fig. 2.4). Two corresponding fan-shaped networks of lines are inscribed, with the names of the months in the Alexandrian calendar abbreviated in Greek (six on each scale), and ten-day intervals marked out. From the 20s BCE onward the Alexandrian calendar for the most part corresponds to the Julian calendar, although the starting points of the months differ; see Stern (2012), 26. The month names at the end nearer the latitude figures are listed first (English translation with full month names follows):

ΤΥ	ΜΕΧ	ΦΑΜΕΝ	ΦΑΡΜΟ	ΠΑΧ	ΠΑ
ΕΠ	ΜΕC	ΘΩΘ	ΦΑΩΦ	ΑΘΥ	ΧΟ

Tybi	Mechir	Phamenoth	Pharmouthi	Pachon	Payni
Epiphi	Mesore	Thoth	Phaophi	Athyr	Choiak

In addition, on either side of these networks and partly overlapping them, a pair of further networks is drawn, each divided into segments for six months (only; no subdivision within months); the same abbreviations for their names are used as above. However, all twelve of the month names are included in each of these networks, inscribed in two rows much as shown immediately above here, *except* that in the upper row the order of months and the spelling of the abbreviation for each are presented in reverse (with minor spelling variants). So this row should be read from right to left (Greek boustrophedon-style); it spans the months Tybi to Payni. The lower row, to be read left to right, spans Epiphi to Choiak (English translation with full month names follows).

What purpose these further networks were to serve is not clear; the possibility remains open that von Tischendorf’s drawing does not place them or reproduce them altogether accurately (de Solla Price 1969, 259).

ΑΠ	ΧΑΠ	ΟΜΨΑΦ	ΙΞΜΑΦ	ΙΧΞΜ	ΥΤ
ΕΠ	ΜΕCΟ	ΘΩΘ	ΦΑΩΦΙ	ΑΘΥΡ	ΧΟ

Payni	Pachon	Pharmouthi	Phamenoth	Mechir	Tybi
Epiphi	Mesore	Thoth	Phaophi	Athyr	Choiak

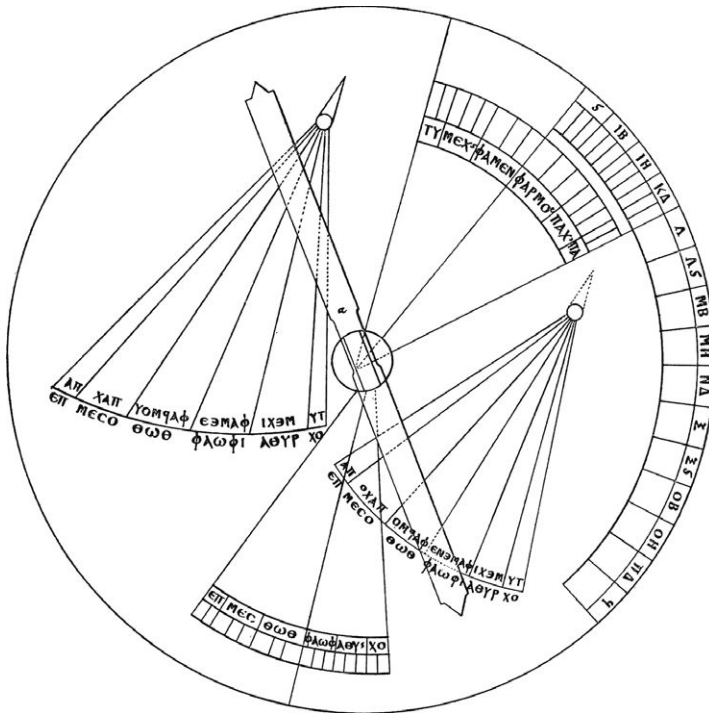


FIGURE 2.4 Memphis, no. 3: obverse drawing by Constantin von Tischendorf (1860).

From von Tischendorf's publication.

On the **reverse**, thirty-six names are inscribed in Greek, each with a corresponding latitude figure (Fig. 2.5 and Map 2.2). A line separates each name and figure from the next, but no line separates each name from its corresponding figure. The names run out from just beyond the central hole, and the figures are spaced considerably beyond, near the rim. Von Tischendorf was unable to read three names and one figure.

Conceivably, the latitude figure for Carthage ($\Lambda\text{B}\Gamma_{\circ} = 32.66$) is a slip for $\Lambda\text{B}\Gamma$ (32.33), given that the figures for the preceding name (Caesarea) and the following one (no longer recoverable) are 32 and 32.5 respectively. Likewise, the figure for Thrace ($\text{MA} = 41$) may be a slip for $\text{M}\Delta$ (44), which is to be expected from the name's placement in the list.

ΙΝΔΙΑ	Η	India (<i>see comment below</i>)	8	11–north	~8–north
ΜΕΡΟΗ	ΙΣΕ	Meroe	16.5*	16 25	17 00
ΣΟΗΝΗ	ΚΓ<	Syene	23.5	23 50	24 00
ΒΕΡΟΝΙΚΗ	ΚΓ<	Berenice	23.5	23 50	24 00
ΜΕΜΦΙΣ	Λ	Memphis	30	29 50	29 50
ΑΛΕΞΑΝΔΡΙ	ΛΑ	Alexandria	31	31 00	31 10
ΠΕΝΤΑΠΟΛΙΣ	ΛΑ	Pentapolis	31	31 00–31 40	~32–33
ΒΟΣΤΡΑ	ΛΑ<	Bostra	31.5	31 30	32 30
ΝΕΑΠΟΛΙΣ	ΛΑΓ _ο	Neapolis (<i>Palestine?</i>)	31.66	31 50	31 30
ΚΕΣΑΡΙΑ	ΛΒ	Caesarea (<i>Palestine?</i>)	32	32 30	32 30
ΚΑΡΧΗΔΩΝ	ΛΒΓ _ο	Carthage	32.66*	32 40	36 50
[illegible]	ΛΒ<	?	32.5		
[illegible]	[illegible]	?	[in 32.5–33.66 range?]		
[illegible]	ΛΓΓ _ο	?	33.66		
ΓΟΡΤΥΝΑ	ΛΔ<	Gortyn	34.5	34 50	35 00
ΑΝΤΙΟΧΙΑ	ΛΕ<	Antioch (<i>Syria?</i>)	35.5	35 30	36 10
ΡΟΔΟΣ	ΛΣ	Rhodes	36	36 00	36 25
ΠΑΜΦΥΛΙΑ	ΛΣ	Pamphylia	36	36 30–38 30	~37–38
ΑΡΓΟΣ	ΛΣ<	Argos (<i>Peloponnese?</i>)	36.5	36 15	37 40
ΣΟΡΑΚΟΥΣΑ	ΛΖ	Syracuse	37	37 (15)	37 10
ΑΘΗΝΑΙ	ΛΖ	Athens	37	37 15	38 00
ΔΕΛΦΟΙ	ΛΖΓ _ο	Delphi	37.66	37 40	38 30
ΤΑΡΣΟΣ	ΛΗ	Tarsus	38	36 50	36 50
ΑΔΡΙΑΝΟΥΠΟΛΙΣ	ΛΘ	Adrianople (<i>Stratoniceaea?</i>)	39	omitted by Ptolemy	39 10
ΑΣΙΑ	Μ	Asia	40	35 30–41 30	~36–40
ΗΡΑΚΛΕΙΑ	ΜΑΓ _ο	Heraclea (<i>Lyncestis?</i>) (<i>former Perinthus?</i>) (<i>see comment below</i>)	41.66	40 40 42 20	41 00 41 00
ΡΩΜΗ	ΜΑΓ _ο	Rome	41.66	41 40	41 50
ΑΓΚΥΡΑ	ΜΒ	Ancyra	42	42 00	39 50
ΘΕΣΣΑΛΟΝΙΚΗ	ΜΓ	Thessalonica	43	40 20	40 40
ΑΠΑΜΙΑ	ΛΘ	Apamea (<i>Phrygia?</i>) (<i>Bithynia?</i>)	39	38 55 (39 05) 42 00 (41 55)	38 00 40 20
ΕΔΕΣΑ	ΜΓ	Edessa (<i>Macedonia?</i>) (<i>see comment below</i>)	43	40 20	40 45
ΚΩΝΣΤΑΝΤΙΝΟΥΠΙ	ΜΓ	Constantinople	43	43 05	41 00
ΓΑΛΛΙΑΙ	ΜΔ	Galliai	44	42 10–53 30	~43–51
ΑΡΑΒΕΝΝΑ	ΜΔ	Ravenna	44	44 00	44 20
ΘΡΑΚΗ	ΜΑ	Thrace	41*	40 40–44 40	~40–43
ΑΚΥΛΗΙΑ	ΜΕ	Aquileia	45	45 00	45 40

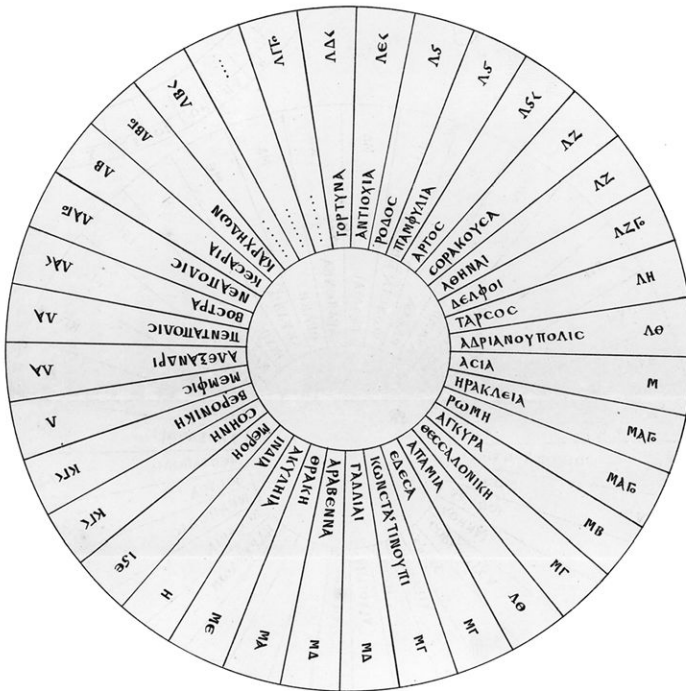


FIGURE 2.5 Memphis: reverse drawing by Constantin von Tischendorf (1860).

From von Tischendorf's publication.

For discussion of where may be meant by India, and which cities by Antioch, Apamea, Caesarea, Edessa, Heraclea, and Neapolis, see Chapter 4 section 2 and Chapter 3 section 4 respectively.

Dating No earlier than the foundation of Constantinople in the 320s.

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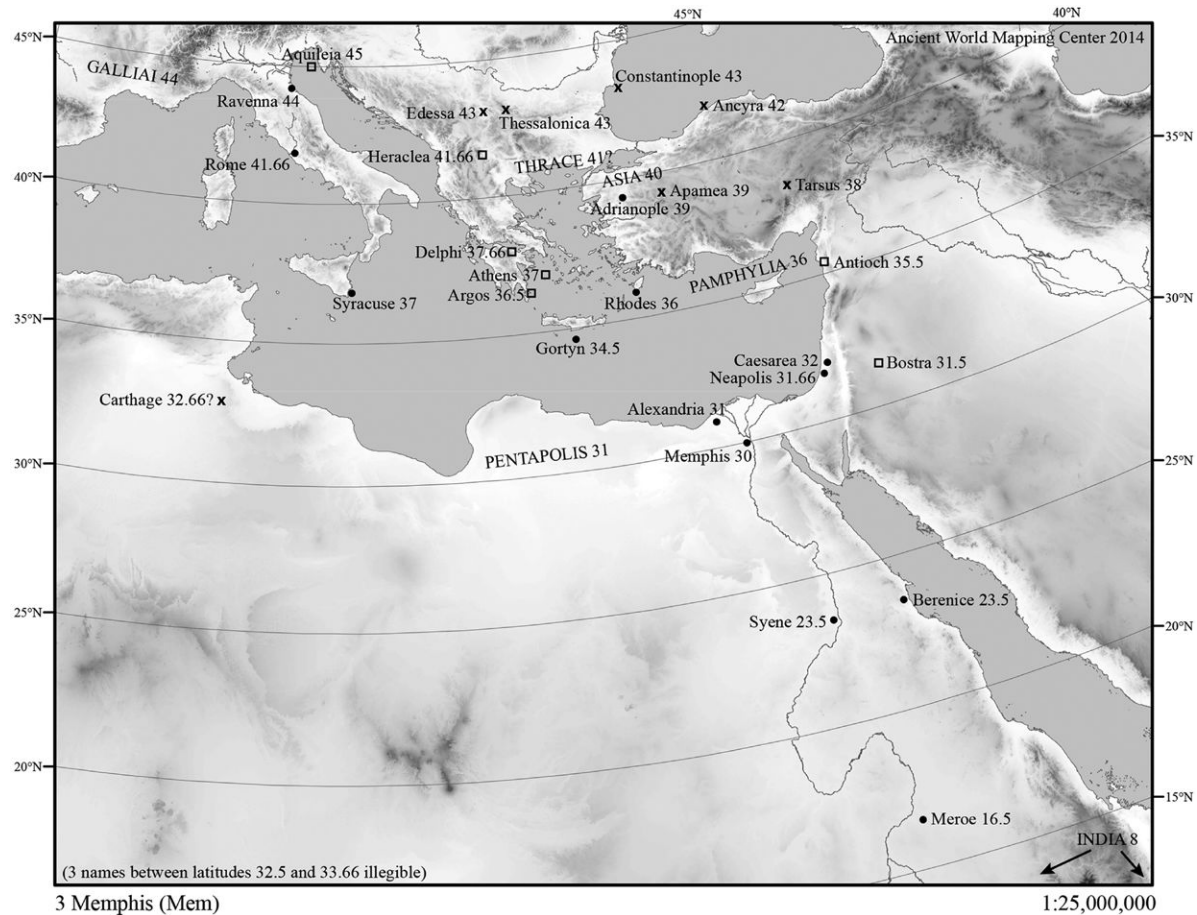
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J. V. Field and M. T. Wright, “Gears from the Byzantines: A Portable Sundial with Calendrical Gearing,” *Annals of Science* 42 (1985): 87–138 at 107–10.

Sacha Stern, *Calendars in Antiquity: Empires, States, and Societies* (2012).

Winter (2013), 424–25 (Memphis no. 2).



MAP 2.2 Memphis, no. 3.
Ancient World Mapping Center.

4 Aquileia (Aqu)

Lost

Material Bronze, with traces of silver

Dimensions Diameter 3.1 cm, depth .75 mm

Provenance and ownership Nothing is known except that this sundial (or disc) was in the private collection of an individual resident near Aquileia when seen and described by Friedrich Kenner (1880, 18–20), whose two sketches are the only existing images, redrawn in Figure 2.6. The disc may well have been one of an otherwise lost set (compare Vienna/Wien, no. 5), as de Solla Price conjectured (1969, 248).

Description There is a small hole in the center. On each side of the disc, there is inscribed a month-and-hour network (with the abbreviated names of the twelve months of the Julian calendar in Latin) in between upper and lower horizontal lines, together with the letters RO in Latin to the left on the **obverse**, and RA likewise on the **reverse**; the networks are reckoned to be drawn for the latitudes of Rome and Ravenna respectively. Kenner's reading of letters does not invariably match what is to be seen on his sketches; in these few instances I follow the latter.

Months on the obverse (the upper row to be read from right to left); note that the abbreviations for March, May, and August form a ligature, as do the V and L of July:

IV	MA	AP	MA	FE	IA
IVL	A/	SE	OC	NO	DE

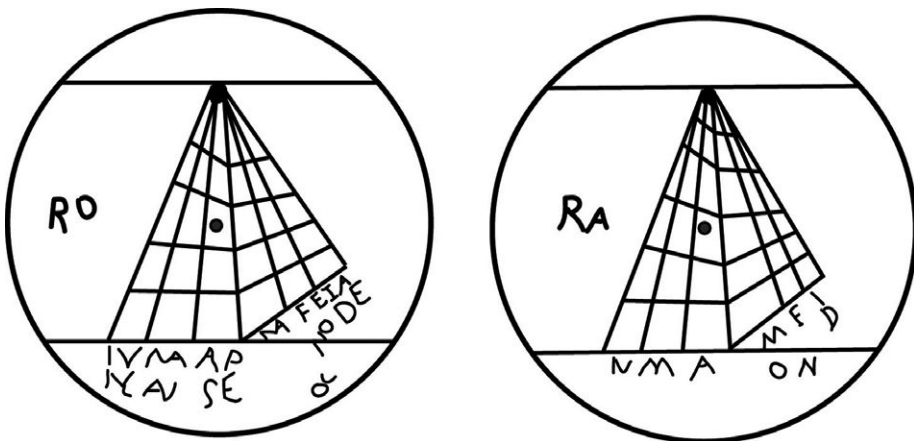


FIGURE 2.6 Aquileia, no. 4: sketch by Friedrich Kenner (1880).

Redrawn from Kenner's publication by the Ancient World Mapping Center.

Months on the reverse (the upper row to be read from right to left):

IV	M	A	M	F	I
illegible	illegible	illegible	O	N	D

Dating uncertain

Bibliography

Friedrich Kenner, "Römische Sonnenuhren aus Aquileia," *Mittheilungen der k. k. Central-Commission zur Erforschung und Erhaltung der Kunst- und historischen Denkmale* 6 (1880): 1–20 at 18–20.

A. Schlieben, "Römische Reiseuhren," *Annalen des Vereins für Nassauische Alterthumskunde und Geschichtsforschung* 23 (1891): 115–28 at 122–24 and fig. 10.

De Solla Price (1969), 248.

Buchner (1976), 330.

Winter (2013), 281–82 (Aquileia no. 11).

5 Kunsthistorisches Museum, Vienna/Wien (Wie)

Vienna, Kunsthistorisches Museum, Antikensammlung inv. no. VI, 4098

Material Bronze

Dimensions Diameter 4 cm, depth 1.4 cm

Provenance and ownership Supposedly found at Aquileia, this sundial has been in the Kunsthistorisches Museum, Vienna, since the eighteenth century.

Description Friedrich Kenner's description (1883, 84–88) was not superseded until de Solla Price (1969, 249–53) offered new findings to consider in the light of an initiative taken in 1957. These findings subsequently prompted fresh examinations of the sundial's workings and accuracy as a timepiece by Edmund Buchner (1976) and Paolo Auber (2004, evidently written without awareness of Buchner 1976). Use of RTI has since provided a fuller, more confident grasp of the geographical names (see Map 2.3, and Talbert forthcoming for a detailed report).

Outwardly, the sundial resembles a pillbox comprising two pieces, the top one fitting into the bottom one; compare no. 2 (Kircher Museum) above. The **top piece** (Fig. 2.7) appears to be made from the obverse of a coin or medalion bearing in relief the head of the emperor Antoninus Pius with the legend ANTONIN[VS] AVG PIVS P[P] T[R] P COS [III] IMP II. Restored thus, this imperial titulature would be correct between 142 (when Antoninus became imp. II) and 144 (he was cos. IIII in 145).¹¹ On the reverse of the top piece (Fig. 2.8) is drawn

11. See *PIR*² A 1513. He was consul for the third time in 140, and was not hailed Imperator again after 142. In principle the legend could reflect a date during or after his fourth (and last) consulship, but there is hardly space to fit IIII, and the form IV is not attested on his coins; see *RIC* 3 (1930).



FIGURE 2.7 Vienna, no. 5: top obverse.

Photo: KHM-Museumsverband, Vienna, Austria.



FIGURE 2.8 Vienna: top reverse.

Photo: KHM-Museumsverband, Vienna.

a stereographic projection with hour lines and horizon (note discussion by Turner 1985, 10–11, and Chapter 5 section 1). The **bottom piece** (Fig. 2.9) portrays on its reverse a pair of horses in profile, one prancing to the left, the other to the right. Reasonably enough, they have been considered part of a four-horse chariot (*quadriga*) image, but only the pair of horses is now visible on this surface.

A marked contrast between the thickness of the top (1.5 mm) and bottom (6 mm) pieces as originally found was for long a feature that attracted attention. It was suspected that several once-separate discs had become fused to each other and to the bottom. Eventually, in 1956, acting on this suspicion de Solla Price persuaded the Kunsthistorisches Museum that an attempt should be made to investigate the possibility and, if it were confirmed, to pry the discs apart. This dismantling was successfully achieved the following year. Four discs were separated (diameter 3.6 cm, thickness 1 mm), each with a small hole in the same spot about 9 mm from the edge. Serious damage to some of the sides became apparent, but at least all eight could now be examined, whereas before only one side (4 Rev. below) was visible. On all eight sides a typical month and six-hour scale are lightly inscribed (with the abbreviated names of the twelve



FIGURE 2.9 Vienna: bottom reverse.

Photo: KHM-Museumsverband, Vienna.

months of the Julian calendar in Latin), together with one geographical name in Latin at the top just above the small hole, and another such name more or less lower down to the left. These names, as well as those of the months, are inscribed more deeply. No. 4 above, also from the Aquileia vicinity, is no doubt a disc of the same type from a comparable sundial otherwise lost.

Months (the upper row to be read from right to left):

IVN	MAI	APR	MAR	FEB	IAN
IVL	AVG	SEP	OCT	NOV	DEC

The obverse of the sundial's bottom piece is a blank surface, onto which a small protruding post has been riveted—as is visible on the reverse—to accommodate the hole of each disc (Fig. 2.10). The sundial's user selects the desired side of the eight possible and puts it in place. Over the month and hour scale the user next lines up a “hand” (as of a clock)—which survived to a length of 6 mm—for the required time of year (Fig. 2.11). A short (1.2 mm) wedge, which passes through the post, firmly secures both the discs and the hand. Made ready in this way, the sundial's bottom piece is then set up vertically, presumably



FIGURE 2.10 Vienna: bottom obverse with post.

Photo: KHM-Museumsverband, Vienna.



FIGURE 2.11 Vienna: bottom obverse with “hand” and wedge.

Photo: KHM-Museumsverband, Vienna.

on any available surface, or at least no means of suspending it seems to be provided. When the sun shines, rays pass onto the hand through the V-shaped slit (originally perhaps just a tiny pinhole) cut into the edge of the piece (visible to the left in Figs. 2.10 and 2.11), as envisaged in Figure 1.7. Sometime during the recent past the hand and the wedge seen in Figure 2.11 went missing, and as yet have not been recovered. A sharper photograph of them is not available.

For recording purposes, the ordering of the discs and the determination of obverse/reverse on each can be no more than subjective choices. Those made here are my own, but I also note those of de Solla Price (SP), together with Edmund Buchner’s (EB) Tafel numbers. Figures 2.12 to 2.22 present specular enhanced images (explained at the start of this chapter) of all eight sides together with—for 1 Rev, 3 Obv, and 4 Rev—a tracing of what may be seen of each geographical name’s lettering, as well as of each month and hour scale’s line work. In the column for names, an underdot appears below any letter that still cannot be read with confidence; no attempt is made to propose letters that have become wholly illegible.

Dating Sometime from the 140s CE onward; how far onward is impossible to determine. In particular, any presumption that the sundial was created

1 Obv (Fig. 2.12) SP no. 2, EB Taf. 56,3	ALEXAN AEGYP	Alexandria Egypt
1 Rev (Figs. 2.13, 2.14) EB Taf. 56,4	BRITT GERMAN	Britannia Germania
2 Obv (Fig. 2.15) SP no. 3, EB Taf. 57,1	HELLADE ASIA	Hellas Asia
2 Rev (Fig. 2.16) EB Taf. 57,2	AFRICA ÇARTH	Africa Carthage
3 Obv (Figs. 2.17, 2.18) SP no. 1, EB Taf. 57,4	ROM NÇ	SP and EB: MRTI (= Mauretania) SP: <EPI>RVS EB: illegible Rome Neapolis?
3 Rev (Fig. 2.19) EB Taf. 56,2	ANCONA TVSCIA	Ancona Tuscia
4 Obv (Fig. 2.20) SP no. 4, EB Taf. 57,3	HISPANIA CAMPA	Spain Campania?
4 Rev (Figs. 2.21, 2.22) EB Taf. 56,1	GALLIA BVRDICA	SP: xxxNxx EB's proposal (from the month and hour scale): GALLIA SP: illegible EB's conjecture: NARBOS Gallia Burdigala

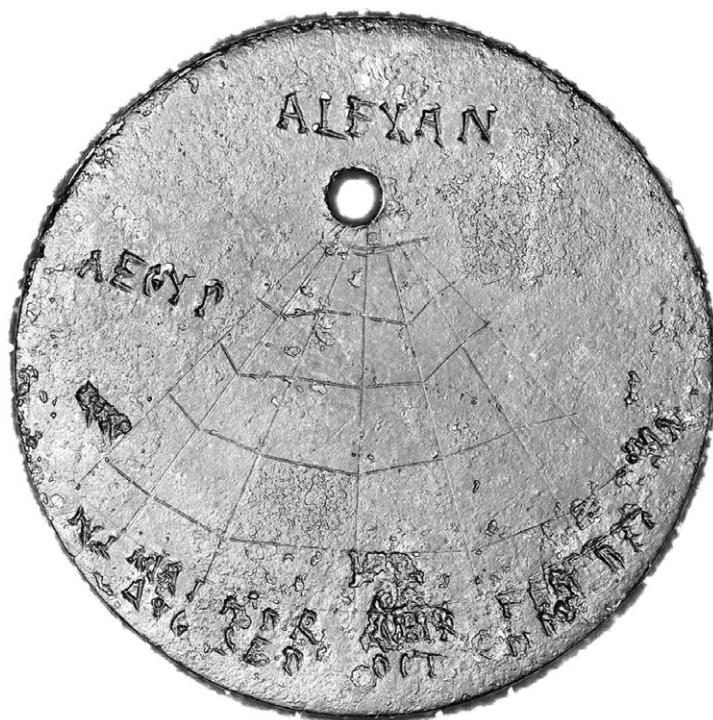


FIGURE 2.12 Vienna: disc 1 obverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.



FIGURE 2.13 Vienna: disc 1 reverse.

Photo KHM-Museumsverband, Vienna, and Michael Fergusson.

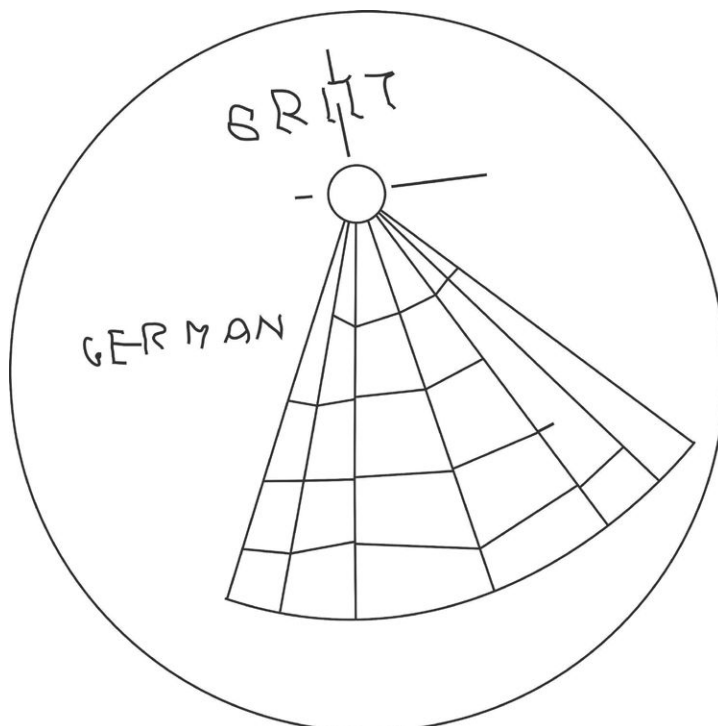


FIGURE 2.14 Vienna: partial reconstruction of disc 1 reverse.

Ancient World Mapping Center.



FIGURE 2.15 Vienna: disc 2 obverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.



FIGURE 2.16 Vienna: disc 2 reverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.

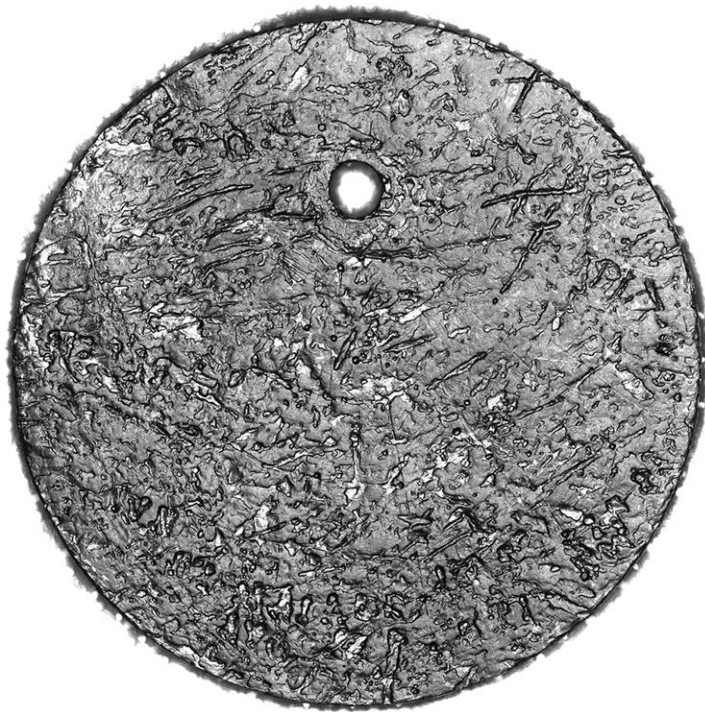


FIGURE 2.17 Vienna: disc 3 obverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.

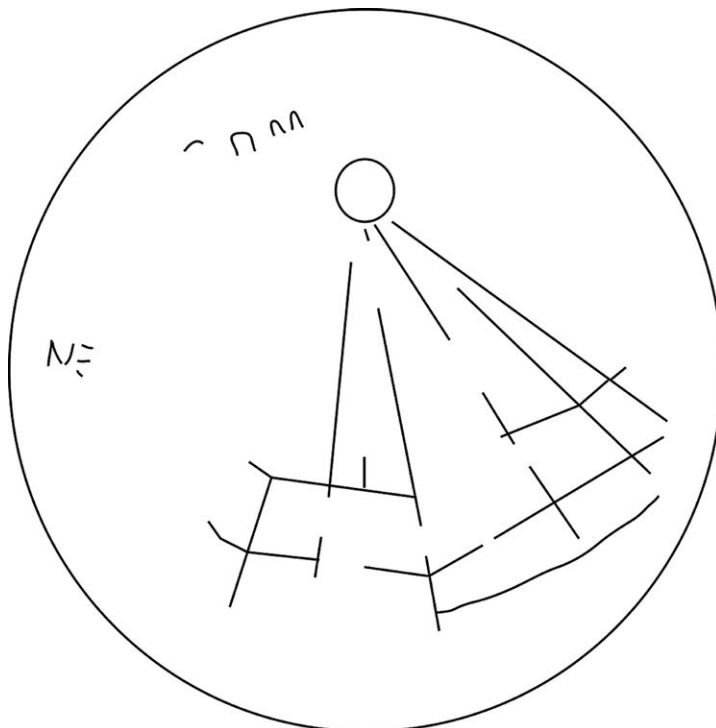


FIGURE 2.18 Vienna: partial reconstruction of disc 3 obverse.

Ancient World Mapping Center.



FIGURE 2.19 Vienna: disc 3 reverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.



FIGURE 2.20 Vienna: disc 4 obverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.



FIGURE 2.21 Vienna: disc 4 reverse.

Photo: KHM-Museumsverband, Vienna, and Michael Fergusson.

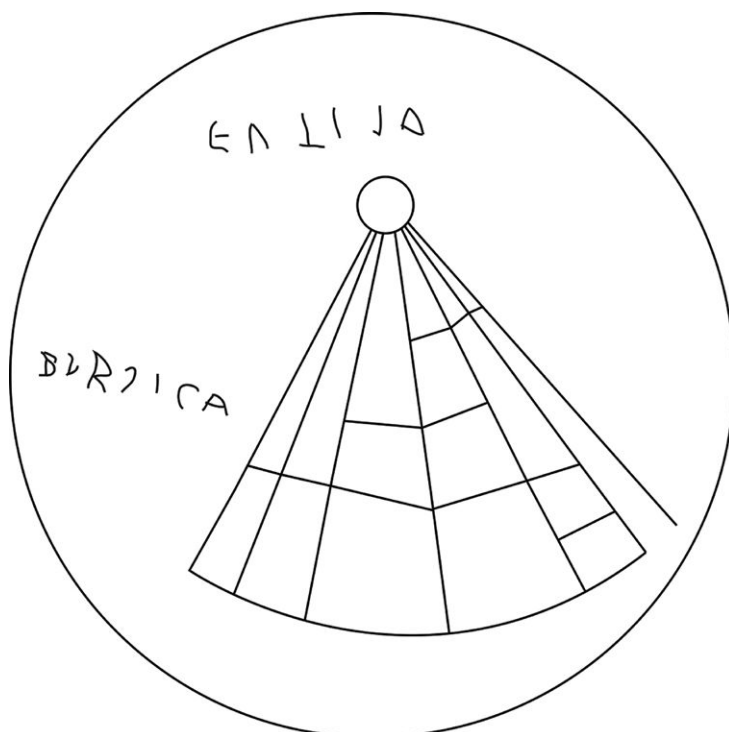
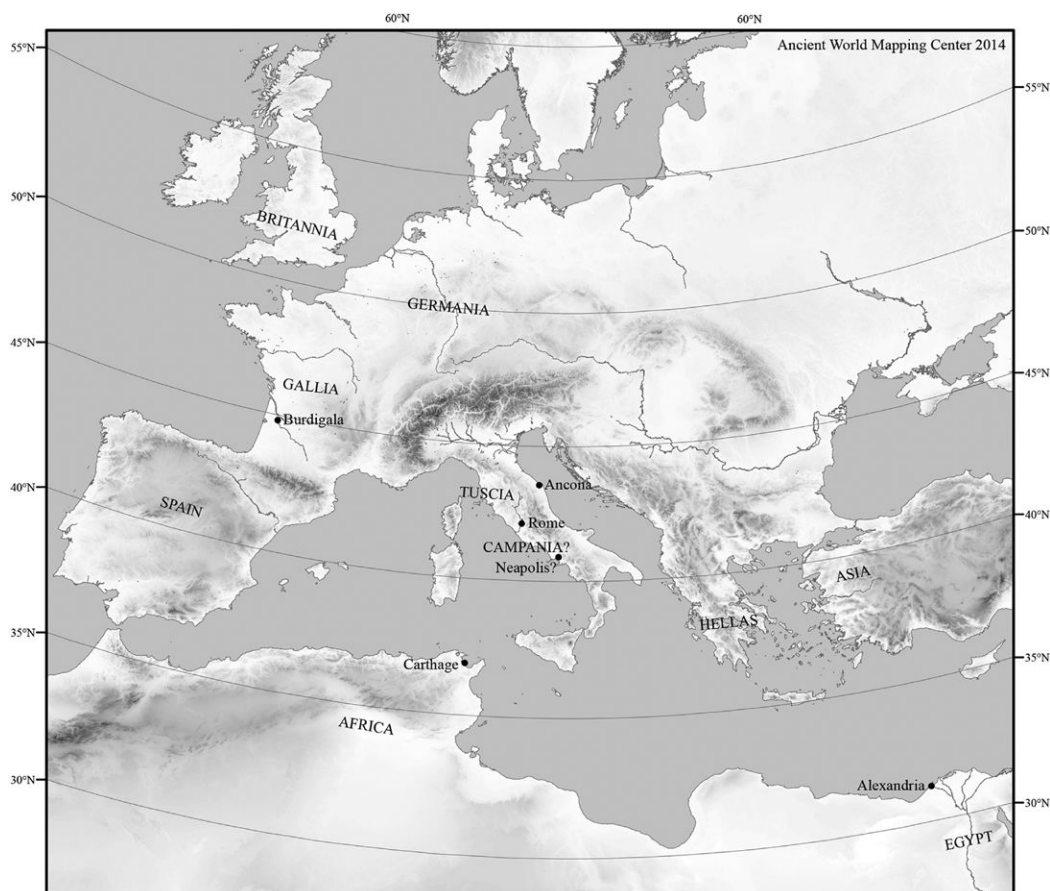


FIGURE 2.22 Vienna: partial reconstruction of disc 4 reverse.

Ancient World Mapping Center.



5 Vienna (Wie) with all names at their correct latitudes

Scale 1:22,500,000

MAP 2.3 Vienna, no. 5.

Ancient World Mapping Center.

from an actual coin of Antoninus Pius, let alone during his reign in the mid-second century, is liable to be mistaken. *RIC* 3 (1930) lists no coin of Antoninus Pius with the obverse legend here, which is notable in particular for its omission of the regular initial *IMP CAES* from the imperial titulature. In addition, it is common for the titles that follow the emperor's name on the obverse here to appear instead on the reverse (of *aurei* and *denarii* especially). Plenty of Antoninus' coins continued to circulate far into the third century (Rowan 2013, 236–37), so an engraver during this long span, or even later, could readily opt to create an adaptation of one or more obverses. Like no. 2 above (Kircher Museum), this sundial cannot be considered an example of a Roman coin removed from circulation and reused for a nonmonetary purpose (cf. Rowan 2009, 5).

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6 Crêt-Châtelard (Crê)

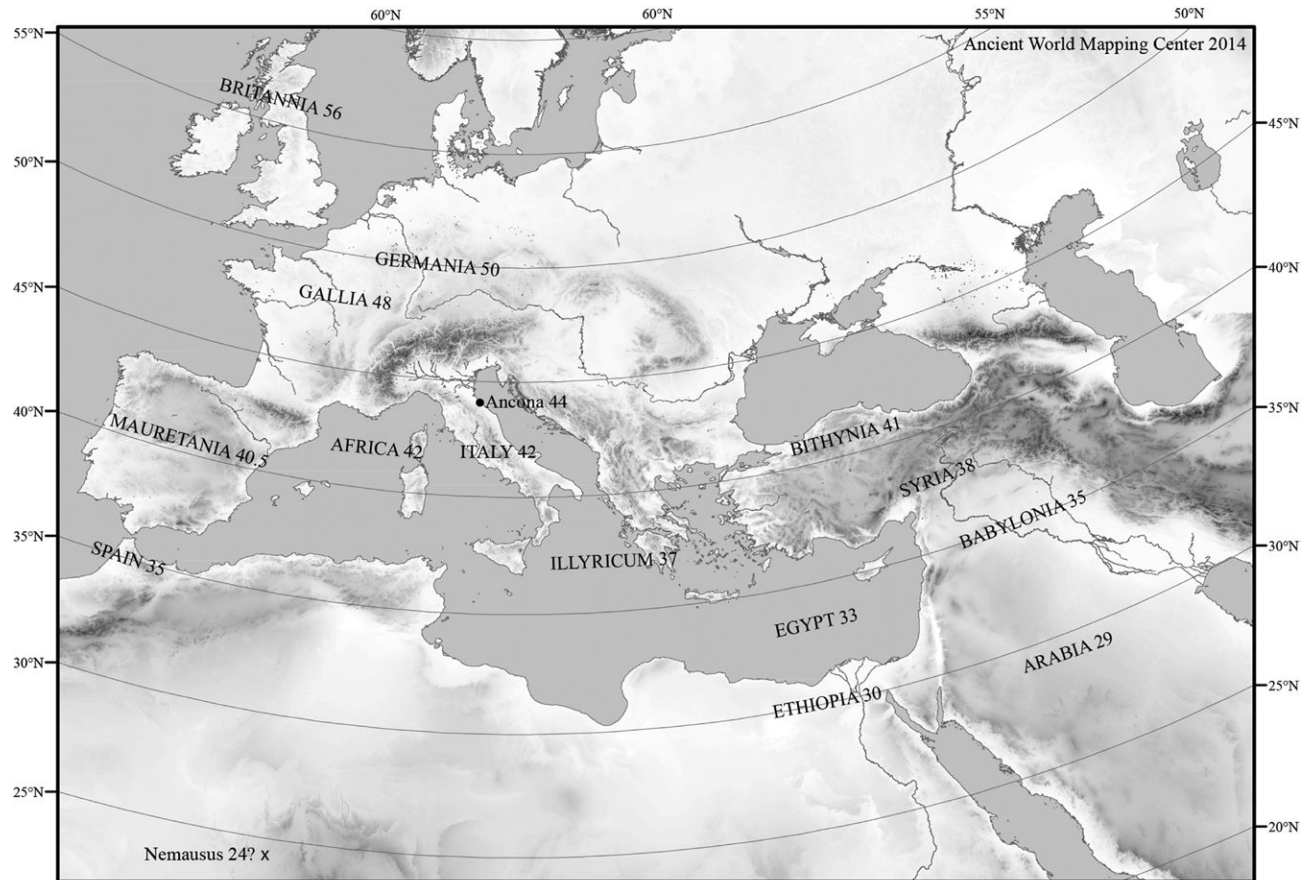
Lost

Material Silver-plated bronze ("bronze plaqué d'argent," according to Durand and de la Noë 1896, 7)

Dimensions Diameter 5.65 cm, depth 3 mm

Provenance and ownership Random find made in the mid-1830s by a farmer on the site of the settlement (of the Roman period, its ancient name unknown) at Crêt-Châtelard in the commune de Saint Marcel de Félines on the east bank of the Loire river (*BAtlas* 17 C2). The sundial had a succession of owners, but could no longer be traced after the 1870s; Otto Hirschfeld (*CIL* XIII [1916]. 11173) records a rumor that it was acquired by an antique dealer in Paris. The drawings published by Vincent Durand in the late 1890s were his own, made during the 1870s. He and Auguste Chaverondier excavated extensively at the site between 1872 and 1887.

Description The only description and drawings are by Durand and Gaston de la Noë (Fig. 2.23); there are no photographs. This sundial was evidently quite well preserved, except that (like Rome, no. 1) the upright shadow caster at



6 Crêt-Châtelard (Crê)

1:32,500,000

MAP 2.4 Crêt-Châtelard, no. 6.

Ancient World Mapping Center.

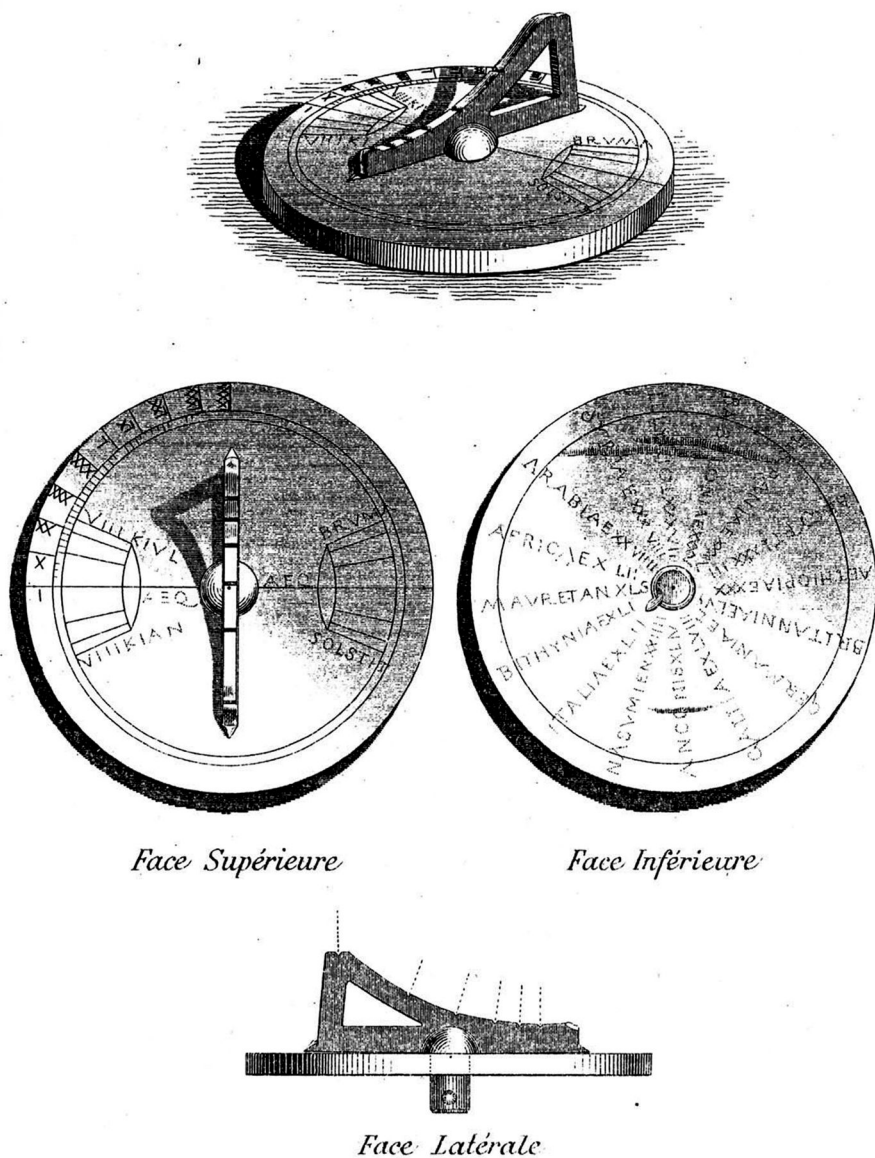


FIGURE 2.23 Crêt-Châtelard, no. 6: drawing by Vincent Durand.

Durand and de la Noë, *Mémoires* 1898, fig. 1 (facing p. 1).

the end of the hour scale had broken off. However, unlike no. 1, there appears to have been only a single disc, not an inner and outer pair. There is a diameter line on the **obverse**; it is identified on either side of the central hole for the hour scale by the abbreviation **AEQ** (below the line to the left, above it to the right) as marking the equinoxes. An identical fan-shaped network of lines is drawn at

each end of this line. The lefthand network is framed at the top by the Latin abbreviation VIII KIVL (*VIII Kal Iul* = June 24 in the Julian calendar), and at the bottom by VIIIKIAN (*VIII Kal Ian* = December 25), denoting the summer and winter solstices respectively. The righthand network is framed at the top by BRVMA, and at the bottom by SOLSTIT, signifying the winter and summer solstices. On each side, above and below the diameter line, two subdividing lines are drawn (as at the righthand side of Rome, no. 1). Immediately beyond the lefthand network, 2-degree latitude intervals are marked clockwise; the marker line is extended to the edge of the obverse every 10 degrees from one to ninety, and a figure is placed just below this line (I, X, XX, XXX, XXXX, L, LX, LXX, LXXX, LXXXX). Six divisions are marked along the hour scale.

On the **reverse**, sixteen names—all starting from the rim—are inscribed in Latin, each followed by a latitude figure; no divider separates each name from its figure (Map 2.4). Although the range of the latitudes marked out on the obverse of the Rome sundial (no. 1) is distinctly more limited, the names and latitude figures on its reverse are altogether similar to those here.

AETHIOPIAE	XXX	Ethiopia	30	~south-23 50	~south-24
AEGYPTI	XXXIII	Egypt	33	23 50-31 20	~24-31
HISPANIAE	XXXV	Spain	35	36 00-46 00	~36-44
BABYLONIAE	XXXV	Babylonia	35	35 00 (<i>city</i>)	32 40
ILLYRICI	XXXVII	Illyricum	37	41 00-45 00	~41-46
SYRIAE	XXXVIII	Syria	38	31 00-38 00	~32-37
ARABIAE	XXVIII	Arabia	29	28 30-31 40	~28-33
AFRICAЕ	XLII	Africa	42	25 00-33 20	~south-37
MAVRETAN	XLS	Mauretania	40.5	25 00-36 00	~south-36
BITHYNIAE	XLI	Bithynia	41	41 15-43 30	~40-42
ITALIAE	XLII	Italy	42	38 00-45 00	~38-46
NASVMIEN	XXIII	Nasumien = Nemausus?	24*	44 30	43 50
ANCONIS	XLIV	Ancona	44	43 40	43 40
GALLIAE	XLVIII	Gallia	48	42 10-53 30	~43-51
GERMANIAE	L	Germania	50	45 30-56 00	~47-54
BRITANNIAE	LVI	Britannia	56	51 30-59 00	~50-59

Given the placement of the name in the list, it is reasonable to regard the latitude figure XXIII (24) for NASVMIEN as a slip for XLIII (44).

Dating Uncertain

Bibliography

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- the Society's meetings on March 24 and 31, 1897; on the latter occasion, Antoine Héron de Villefosse explained the special interest of the geographical names (*Bulletin de la Société nationale des antiquaires de France* [1897]: 204 and 207–208).
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- Winter (2013), 610–11 (Fundort unbekannt no. 13).

7 Museum of the History of Science, Oxford (Oxf)

Museum of the History of Science, Oxford, inv. no. 51358: www.mhs.ox.ac.uk/collections/imu-search-page/record-details/?TitInventoryNo=51358&querytype=field&thumbnails=on&irn=3237 (with images)

Material Bronze

Dimensions Diameter 6.1 cm, depth 2.5 mm

Provenance and ownership Random find, purchased by Lewis Evans (1853–1930) not long before 1900. In his contribution to a book published that year (Gatty 1900, 190), Evans states only that “[it] has recently come into my possession, and though the place in which it was found is uncertain...” In the published version of a lecture delivered in 1903 he says that it was found “in Austria” (Evans 1904, 8). However, his later record reads: “Bought from H. Heilbronner Paris 1896 (?) for 50/-. It is said to have been dug up near Presberg [= Bratislava, Slovakia today].” The initial H here is no doubt a slip for R; Raoul Heilbronner was a prominent Paris antiques dealer up to 1914. The sundial was donated by Evans as part of his extensive collection of these and other instruments on the establishment of Oxford’s Museum of the History of Science in 1925.

Description This sundial is fully preserved (Figs. 1. 9–10 and 2.24). Evans’s 1900 and 1904 publications both include a drawing of the obverse, as does the brief record by his friend Robert Gunther (1923, 17–18), which is also illustrated with rubbings of both obverse and reverse. There are outer and inner discs (like Rome, no. 1, presumably). The inner disc is bolted in between the shadow caster and hour scale above it and the outer disc below; the bolt and its pin both survive (Fig. 1.10B). With the aid of the knob visible on the **obverse**, the inner disc is rotated so that the radius line on which the knob is placed meets the latitude chosen by the user, as marked on the rim of the outer disc. Here, a succession of four equally spaced short lines is inscribed, with the Latin figures

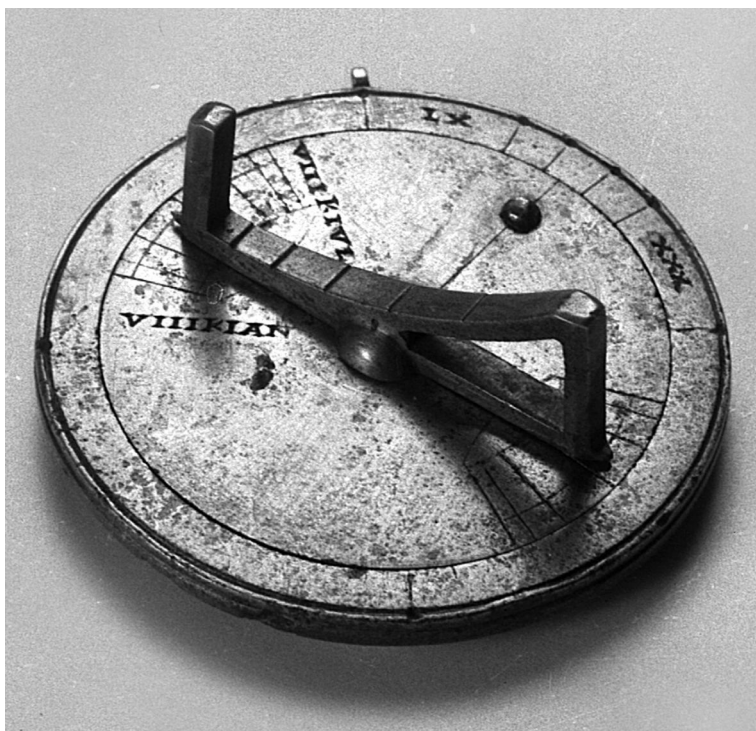


FIGURE 2.24 Oxford, no. 7: obverse.

Photo: Museum of the History of Science, University of Oxford.

XXX and LX beyond each end counterclockwise signifying latitudes 30 and 60 respectively; thus the two intermediate lines mark latitudes 40 and 50. The engraver even continued all four of these lines onto the bed of the outer disc, which is covered by the inner disc when the sundial's components are assembled (Fig. 1.10A). The figure XXX is placed equidistant between the latitude 30 line and a line beyond for latitude zero; LX is placed likewise, equidistant between the latitude 60 line and a line beyond for latitude 90. Directly across from this line for latitude 90, a corresponding short line is inscribed on the rim (but there is none to correspond to the line for latitude zero). A diameter line marks the equinoxes (although without notation to that effect). An identical fan-shaped network of lines is drawn at each end of this diameter line. At one end (only), the network is bounded by the abbreviations VIIIKIVL (*VIII Kal Iul* = June 24 in the Julian calendar) and VIIIKIAN (*VIII Kal Ian* = December 25), denoting the summer and winter solstices. On each side of the diameter line, two subdividing lines are drawn (as on Rome, no. 1). From the rim of the outer disc, to the left of the figure LX, there protrudes a small ring from which to suspend the sundial. Five divisions are marked along the hour scale, which extends in an arc from the upright shadow caster.

AEGYPT	XXX	Egypt	30	23 50–31 20	~24–31
LYCIAE	XXXI	Lycia	31	35 50–37 40	~36–37
CILICIA	XXXI	Cilicia	31	36 20–37 40	~36–37
ASIAE	XXXI	Asia	31	35 30–41 30	~36–40
GAL	XLVIII	Gallia (<i>see comment below</i>)	48	42 10–53 30	~43–51
CAPPAD	XXXI	Cappadocia	31*	37 30–43 00	~38–41
INSVRIA	XXXVI	Syria (<i>see comment below</i>)	36	31 00–38 00	~32–37
QVIRINE	XXXVIII	Cyrene? (<i>see comment below</i>)	39	31 20	32 20
SARDIN	XL	Sardinia	40	35 30–39 30	~39–41
NARB	XLIII	Narb-o/-ensis	43	43 (15)	43 10
SICILI	XLI	Sicily	41	36 00–38 30	36 40–38 20
AFRCA	XLI	Africa	41	25 00–33 20	~south–37
MAVRT	XL	Mauretania	40*	25 00–36 00	~south–36
ISPAN	XLII	Spain	42	36 00–46 00	~36–44
BRIT	LV	Britannia	55	51 30–59 00	~50–59
ITAL	XLIII	Italy	43	38 00–45 00	~38–46
NARB	XLIII	Narb-o/-ensis	44	43 (15)	43 10
BELG	XLVIII	Belgica	48	45 10–54 00	~47–52
GERS	XLVIII	Germania Superior	49	45 30–50 00	~47–50
GERI	LI	Germania Inferior	51	50 00–54 00	~50–52
ROMA	XLII	Rome	42	41 40	41 50
DACIA	LII	Dacia	52	43 30–48 30	~44–47
PANONI	XLVI	Pannonia	46	44 30–48 00	~45–48
MACEDO	XL	Macedonia	40	38 30–42 00	~39–42
LVGD	XLV	Lugdun-um/-ensis	45	45 50	45 45
TRACIA	XLI	Thrace	41	40 40–44 40	~40–43
GALATI	XLV	Galatia	45	38 40–44 30	~38–42
PHRYGI	XXXVI	Phrygia	36	38 00–41 20	~38–40
BITVNI	XXXV	Bithynia	35	41 15–43 30	~40–42
ITAL	XLII	Italy	42	38 00–45 00	~38–46

Thus the A in NARB and in ITAL on their second occurrence (with different latitude figures) has no cross-bar. A further distinguishing feature is the fact that the latitude figures for BRIT and GER are inset from the double-line circle separating each name from its figure, presumably because the figure in each of these instances is only two letters, or maybe only one in the case of GER (see below); no figure associated with any other name on the reverse is inset likewise, even where there is space available (as for AEGYPT XXX). The group of six with their latitude figures comprises (as indented above):

GAL XLVIII

*

NARB XLIII

*

BRIT LV

*

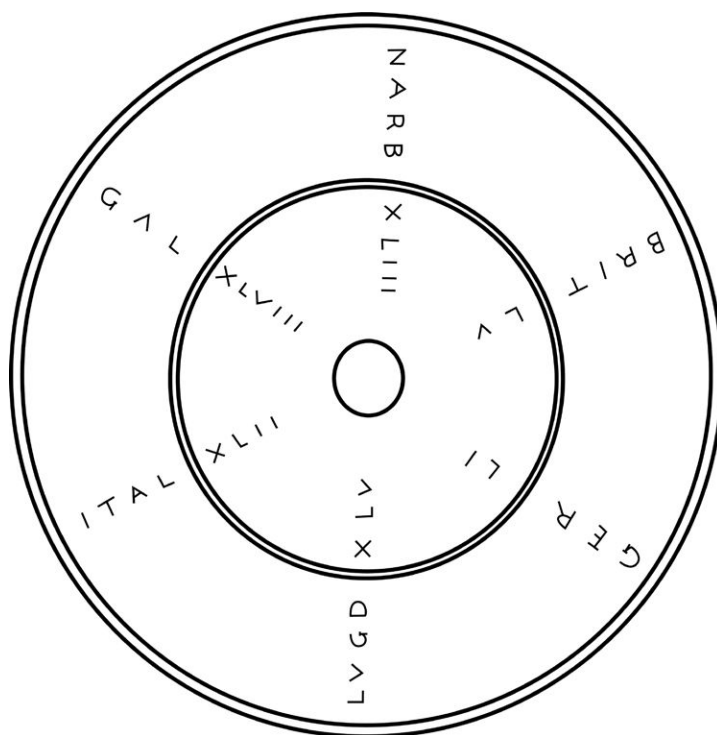


FIGURE 2.26 Oxford: reconstruction of the original reverse.

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GER (*see further below*) LI

*

LVGD XLV

*

ITAL XLII

*

No logical sequence of names or latitude figures is discernible within this group. However, Hagen observed that, if its six names are set aside (or even five, excluding LVGD XLV), then a logical sequence of latitude figures does emerge for the sixteen names inserted—evidently at some later stage—in four groups of four between ITAL XLII, GAL XLVIII, NARB XLIII, BRIT LV, and GER LI:

AEGYPT XXX

LYCIAE XXXI

CILICIA XXXI

ASIAE XXXI

*

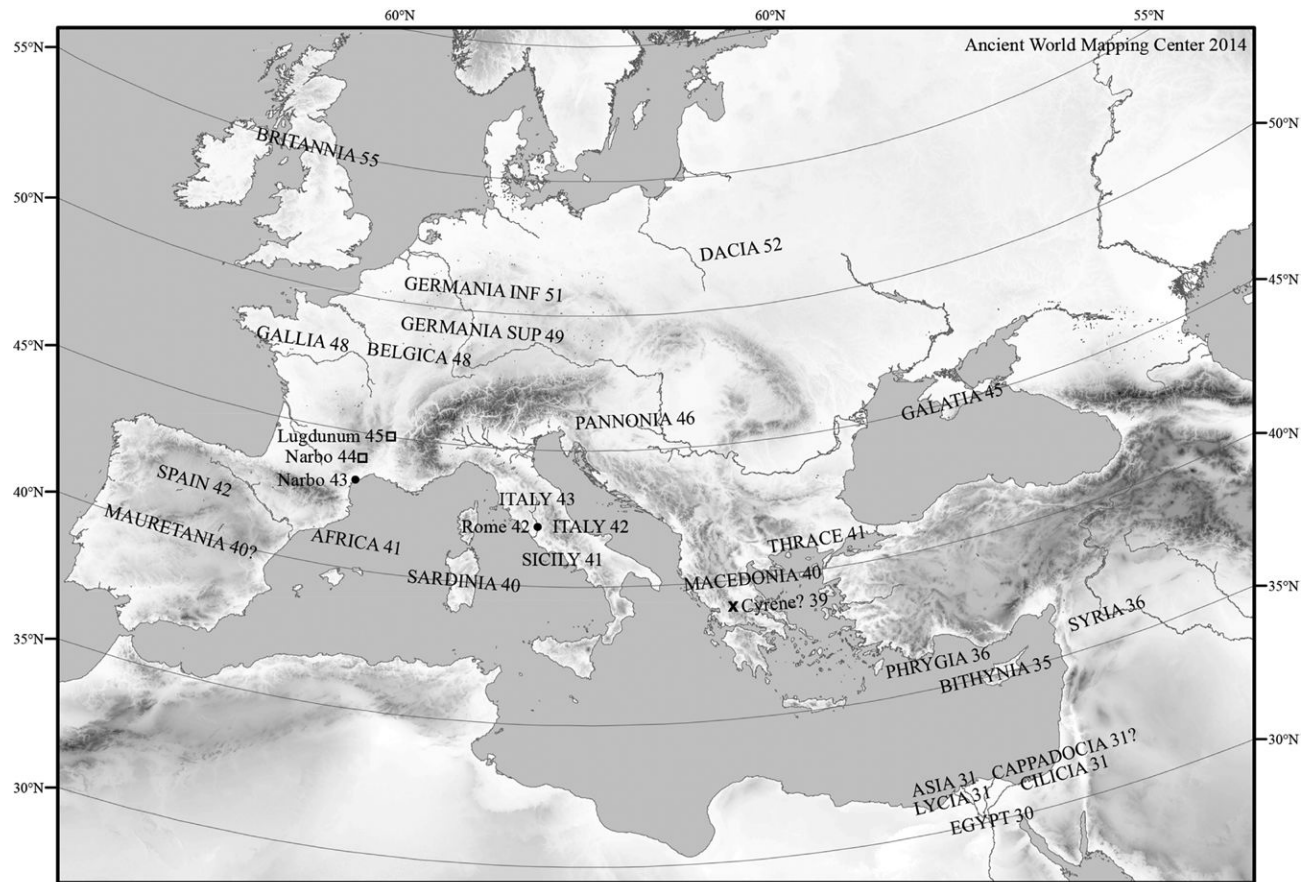
CAPPAD XXXI
 INSVRIA XXXVI
 QVIRINE XXXVIII
 SARDIN XL
 *
 SICILI XLI
 AFRCA XLI
 MAVRT XL
 ISPAN XLII
 *
 ITAL XLIII
 NARB XLVIII
 BELG XLVIII
 GERS XLVIII

Hagen's claim is persuasive, even if the logic of the sequence she identifies is in fact broken once by the occurrence of MAVRT XL between names at latitudes 41 and 42. The likely explanation, however, is that the engraver mistakenly made I the first letter of ISPAN, when the compiler of the list in fact meant it to be the final figure of latitude 41 (XLI) for Mauretania, not the first letter of SPAN. By the same token, the IN in INSVRIA may reflect a similar—and garbled—misplacement of figures meant as the end of the latitude figure for CAPPAD: possibly XXXV or XXXVI, with SVRIA the name to follow.

The reappearance of NARB and ITAL (albeit both now with different latitude figures) among the group of sixteen names inserted through five of the original six evidently did not trouble whoever provided the list of the sixteen. By contrast, it is possible to detect concern at the coincidence that, with the addition of this group, the name for Germany in the added sixteen would appear next to the same name in the original six. Hence, it seems, the opportunity was taken to add I to what (in my opinion) had been no more than GER in the original six, expanding it to GERI and thus reflecting the division of Roman Germany into two provinces. Note that all four letters of GERI as we see them are not evenly spaced (RI in particular), as we might expect if the engraver had been presented with four letters in the first instance rather than three.

Acceptance of Hagen's claim removes any doubt that GAL signifies Gallia rather than, say, Galatia.

In order to accommodate a name with as many as seven letters (which the compiler of the list preferred not to shorten), a ligature is formed for the N and E of QVIRINE. It seems credible that Cyrene is meant, but if this is correct then both the spelling and (more important) the latitude figure XXXVIII



7 Museum of the History of Science, Oxford (Oxf)

1:27,500,000

MAP 2.5 Oxford, no. 7.

Ancient World Mapping Center.

are seriously inaccurate. A convincing alternative name remains elusive, however.

Hagen's identification of sixteen names in a logical sequence of latitudes does not extend to the remaining eight names. They, too, are evidently inserted as successive sets of four between GER LI, LVGD XLV, and ITAL XLII. Since no difference between the style of their lettering and that of the sixteen seems discernible, it is impossible to tell by this means whether these eight were inserted at the same time as the sixteen, or at an earlier stage, or a later one (or even as a group at all, rather than piecemeal). However, the apparent use of two sources for the latitude figures of the regions of Asia Minor in the sixteen and in the eight (see Chapter 4 section 2) reduces the likelihood that all twenty-four names were compiled and added at the same time:

ROMA XLII
 DACIA LII
 PANONI XLVI
 MACEDO XL
 *
 TRACIA XLI
 GALATI XLV
 PHRYGI XXXVI
 BITVNI XXXV

Dating Uncertain. Germany was divided into two Roman provinces (Superior, Inferior) by Domitian during the 80s. It is true that earlier in the first century CE there were two similarly named army commands here, but any dating before the second century seems unlikely (CAH² vol. II, 496–98).

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 Winter 2013, 604–5 (Fundort unbekannt no. 11).
 F. H. King, "Analysis of a Roman Portable Sundial," *Bulletin of the British Sundial Society* 27.3 (2015): 22–29.

8 Aphrodisias (Aph)

Lost? (Aphrodisias Museum, Turkey, inv. no. 63-400)

Material Bronze

Dimensions Diameter 7.55 cm, depth 2 mm; diameter of central hole 7 mm

Provenance and ownership Found in August 1963 among Late Antique houses in the “water-channel” area near the northeastern fortifications of Aphrodisias (*BAtlas* 65 A2). Subsequently placed in the museum’s collection onsite, but no longer traceable there.

Description Only a disc survives, first described briefly, with a photograph of the reverse, by Kenan Erim (1963). Fuller treatments were published subsequently by de Solla Price (1969, 256–60) and Buchner (1971, 471–73); the former offers a photograph of the obverse too, and the latter a drawing of it. Along one quadrant of the **obverse** rim, latitude figures up to 90 are marked off and numbered in Greek figures every 5 degrees clockwise (Figs. 2.27 and 2.28). For figures divisible by ten, the number itself (10, 20, 30, etc.) is



FIGURE 2.27 Aphrodisias, no. 8: obverse.

Photo: Jonathan Blair/Corbis /Boo9648.

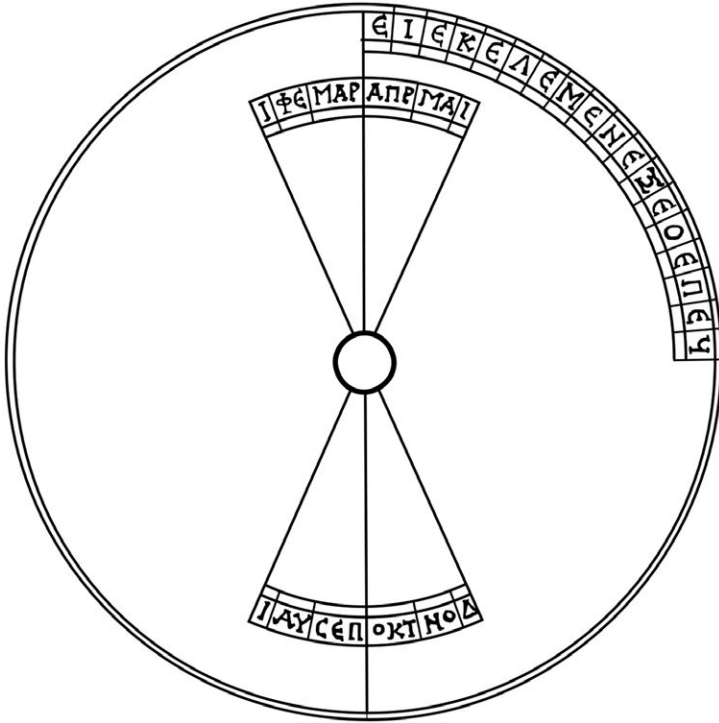


FIGURE 2.28 Aphrodisias: obverse drawing.

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used here; for all the intermediate 5-degree intervals, 5 is simply repeated. At either end of a diameter line a fan-shaped network of lines is inscribed, with the names of the months in the Julian calendar abbreviated in Greek (six on each scale). The abbreviations at the end nearer the latitude figures are listed first:

Ι	ΦΕ	ΜΑΡ	ΑΠΡ	ΜΑ	Ι
Ι	ΑΥ	ΣΕΠ	ΟΚΤ	ΝΟ	Δ

On the **reverse**, twenty-eight names are inscribed in Greek (Figs. 2.29 and 2.30), each with a corresponding latitude figure; a line separates each name *and* figure from the next (Map 2.6). The names are written from just beyond a circle drawn near the center of the disc; much further out, another circle is drawn to separate each name from its figure inscribed close to the rim.

COHHHC	KΓC	Syene	23.5	23 50	24 00
ΜΕΜΦΙC	KΘC	Memphis	29.5	29 50	29 50
ΠΕΛΟΥCΙΟΝ	ΛC	Pelusium	30.5	31 15	31 00
ΑΛΕΞΑΝΔΡC	ΛΑ	Alexandria	31	31 00	31 10
ΠΕΝΤΑΠΟΛΕC	ΛΒ	Pentapoleis	32	31 00–31 40	~32–33
ΧΑΡΤΑΓΩΝ	ΛΓ	Carthage	33	32 40	36 50
ΚΡΗΤΗC	ΛΕ	Crete	35	34 00–35 30	~35–36
ΑΘΗΝΩΝ	ΛΖ	Athens	37	37 15	38 00
ΘΕCΣΑΛΟΝΙΚ	ΜΓ	Thessalonica	43 (<i>see comment below</i>)	40 20	40 40
ΚΥΖΙΚΟΥ	ΜΑ	Cyzicus	41	41 30	40 20
ΝΙΚΟΜΗΔΙΑ	ΜΒ	Nicomedia	42	42 30	40 45
ΚΩΝCΤΑΝΤΙC	ΜΑ	Constantinople	41	43 05	41 00
[.]ΑΛΑΤΙΑ	ΜΒ	Galatia	42	38 40–44 30	~38–42
ΚΑΠΠΑΔΟΚΙΑ	ΛΘC	Cappadocia	39.5	37 30–43 00	~38–41
ΤΑΡCΟΥ	ΛC	Tarsus	36.5	36 50	36 50
ΑΝΤΙΟΧΙΑ	ΛΕΓ	Antioch (<i>Syria?</i>)	35.33	35 30	36 10
ΦΟΙΝΙΚΗC	ΛΓΓ	Phoenice	33.33	32 30–34 30	~33–35
ΠΑΛΕCΤΙΝΗ	ΛC	Palestine	36	30 40–32 30	~31–33
ΚΥΠΡΟΥ	ΛΔ	Cyprus	34	34 40–36 10	34 40–35 40
ΛΥΚΙΑC	ΛΕΓ	Lycia	35.33	35 50–37 40	~36–37
ΠΑΜΦΥΛΙΑ	ΛC	Pamphylia	36.5	36 30–38 30	~37–38
ΡΟΔΟΥ	ΛC	Rhodes	36	36 00	36 25
CΙΚΕΛΙΑC	ΛΗ	Sicily	38	36 00–38 30	36 40–38 20
ΡΩΜΗ	ΜΑC	Rome	41.5	41 40	41 50
ΓΑΛΛΙΩΝ	ΜC	Galliai	46	42 10–53 30	~43–51
ΒΟΥΡΔΙΓΑΛΑ	ΜΕ	Burdigala	45	45 (30)	44 50
CΠΑΝΙΑC	ΜΒ	Spain	42	36 00–46 00	~36–44
ΗΜΕΡΙΤΑ	ΛΘC	Emerita	39.5	39 30	39 00

For the possibility that the letters ΜΓ forming the latitude figure for Thessalonica signify 40.33 rather than 43, see the explanation at the start of this chapter. The order in which the names and figures appear is discussed further below (Chapter 3 section 6 and Map 3.3).

Dating No earlier than the foundation of Constantinople in the 320s.

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 Field and Wright (1985), 89, 106–10, 114.
 Field (1990), 109, 117–23, 132.
 Winter (2013), 270–72 (Aphrodisias no. 6).



FIGURE 2.29 Aphrodisias: reverse.

Photo: Jonathan Blair/Corbis JBoo9644.

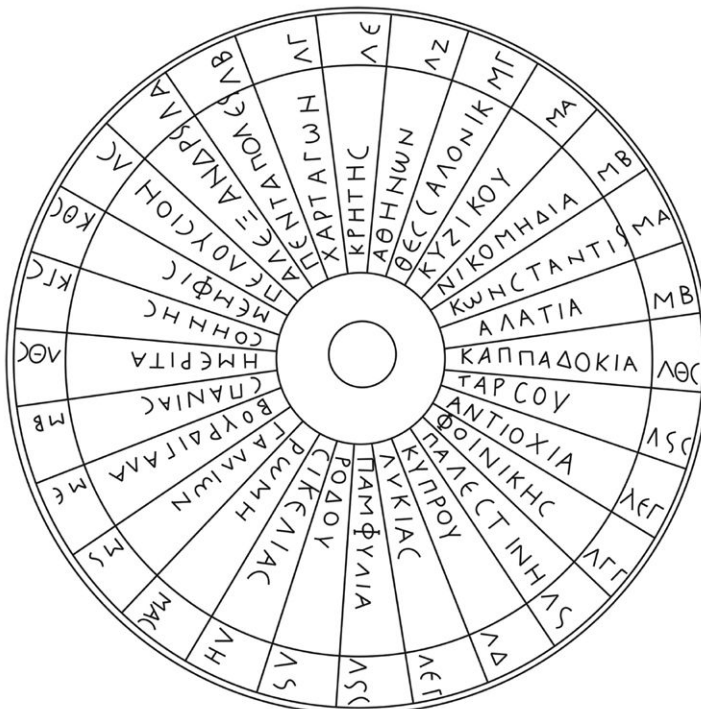
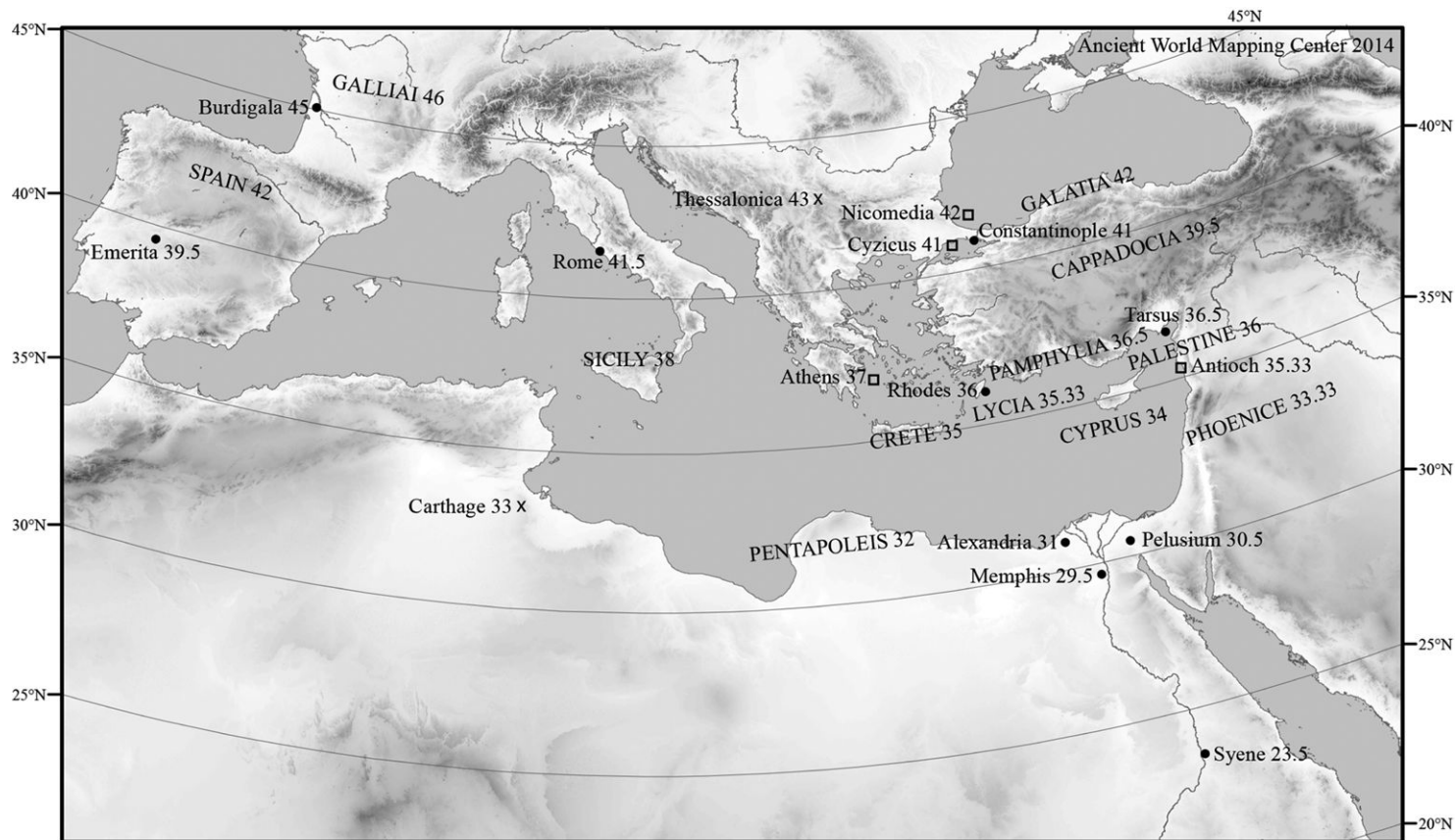


FIGURE 2.30 Aphrodisias: reverse drawing.

Ancient World Mapping Center.



8 Aphrodisias (Aph)

1:27,500,000

MAP 2.6 Aphrodisias, no. 8.

Ancient World Mapping Center.

9 Samos (Sam)

Vathy Archaeological Museum, Samos, Greece, inv. no. 328 (B 1760)

Material Bronze

Dimensions Diameter 6.8 cm

Provenance and ownership Nothing is known about provenance, except that for a long time the sundial was in the possession of the Stavros monastery on Samos, and was seen there by visitors in the late nineteenth century. It was subsequently removed to the Vathy Archaeological Museum, and first published by Renate Tölle (1969).

Description Only a disc survives. Along one quadrant of the **obverse** rim, latitude figures up to 90 are inscribed in Greek figures for every 6 degrees clockwise (Figs. 2.31 and 2.32). There are no divisions between one number and the next, except in the case of 30 and 36. At either end of a diameter line a



FIGURE 2.31 Samos, no. 9: obverse.

Photo: Karlheinz Schaldach.

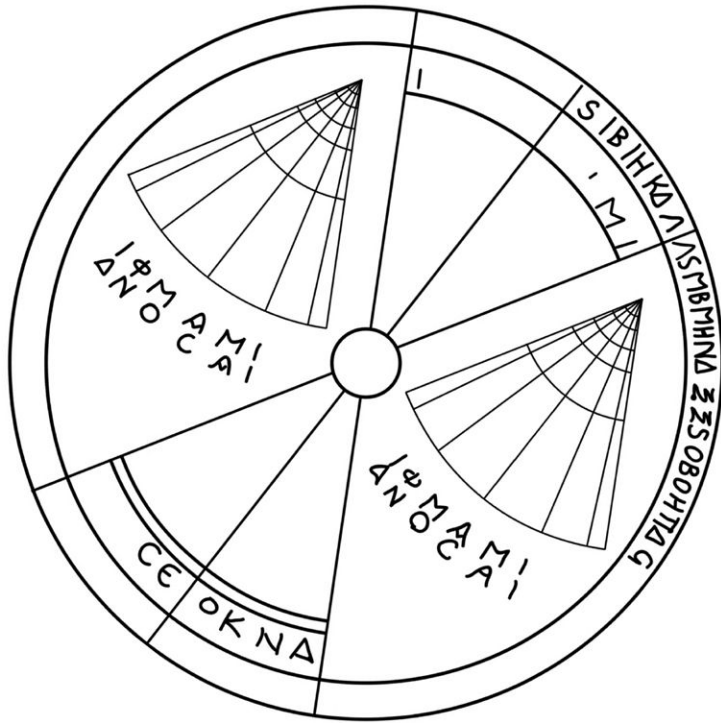


FIGURE 2.32 Samos: obverse drawing.
Ancient World Mapping Center.

fan-shaped network of lines is inscribed, with the names of the months in the Julian calendar abbreviated in Greek (six on each scale). The abbreviations at the end nearer the latitude figures are listed first. In both instances the surface has suffered damage:

I			M	I
	CE	OK	N	Δ

In addition, on either side of the fan-shaped network, a further fan is drawn, each divided into segments for six months. Below each fan, the first letter of all twelve Julian months is inscribed in two rows of six; several of these letters are barely recoverable because of damage to the surface, especially in the lower row on the side nearer the latitude figures. The upper rows (to be read from left to right, I Φ M A M I) span January to June. The lower rows are to be read from right to left (Δ N O C A I, spanning July to December), although—unlike on the Memphis sundial (no. 3)—no letter here is reversed.

On the **reverse**, twelve names (all of cities) are inscribed in Greek (Figs. 2.33 and 2.34), each with a corresponding latitude figure. Each name and its figure

ΡΟΔΟΣ	ΛϚ	Rhodes	36	36 00	36 25
ΛΑΟΔΙΚ	ΛΗ	Laodicea (<i>ad Lycum?</i>) (<i>Katakekaumene?</i>) (<i>see comment below</i>)	38	38 40 39 40	37 50 38 10
ΑΝΚΥΡ	MC	Ancyra	40.5	42 00	39 50
ΝΙΚΙΑ	Μ^	Nicaea	40.33	42 15 (41 55)	40 30
ΗΡΑΚΛ	Μ^	Heraclea (<i>former Perinthus?</i>) (<i>Pontica?</i>)(<i>see comment below</i>)	40.33	42 20 43 30	41 00 41 20
ΚΩΣΤΑ	Μ^	Constantinople	40.33	43 05	41 00
ΧΑΛΚ	Μ^	Chalcedon	40.33	43 05	41 00
ΝΙΚΟΜ	Μ	Nicomedia	40	42 30	40 45
ΑΠΑΜ	ΜΑ	Apamea (<i>Bithynia?</i>)	41	42 00 (41 55)	40 20
ΚΥΖΙΚ	Μ^	Cyzicus	40.33	41 30	40 20
ΜΙΛΙΤ	Λ[.]?	Mytilene? (<i>see comment below</i>)	3[.]?	39 40	39 05
ΕΦΕΣΟ	[?]	Ephesus	[illegible]	37 40	38 00

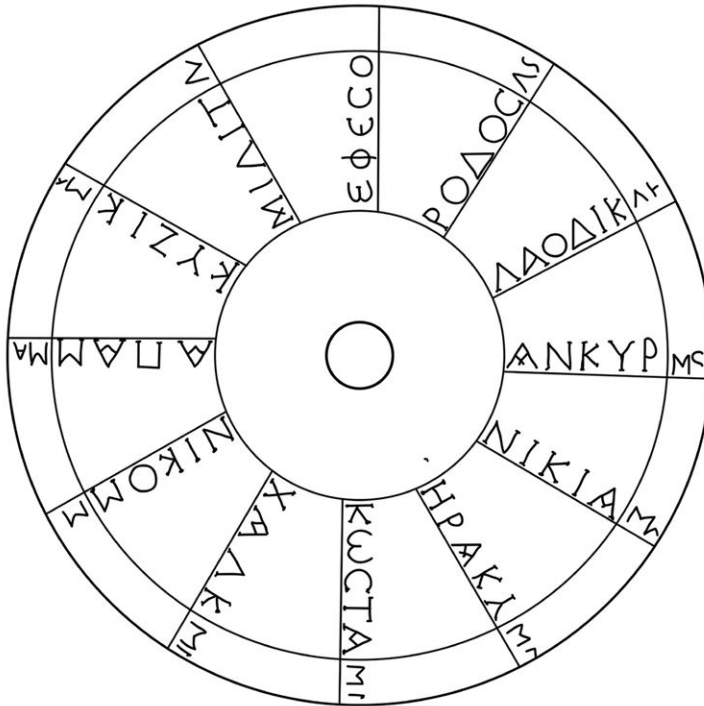


FIGURE 2.33 Samos: reverse drawing.
Ancient World Mapping Center.



FIGURE 2.34 Samos: reverse.

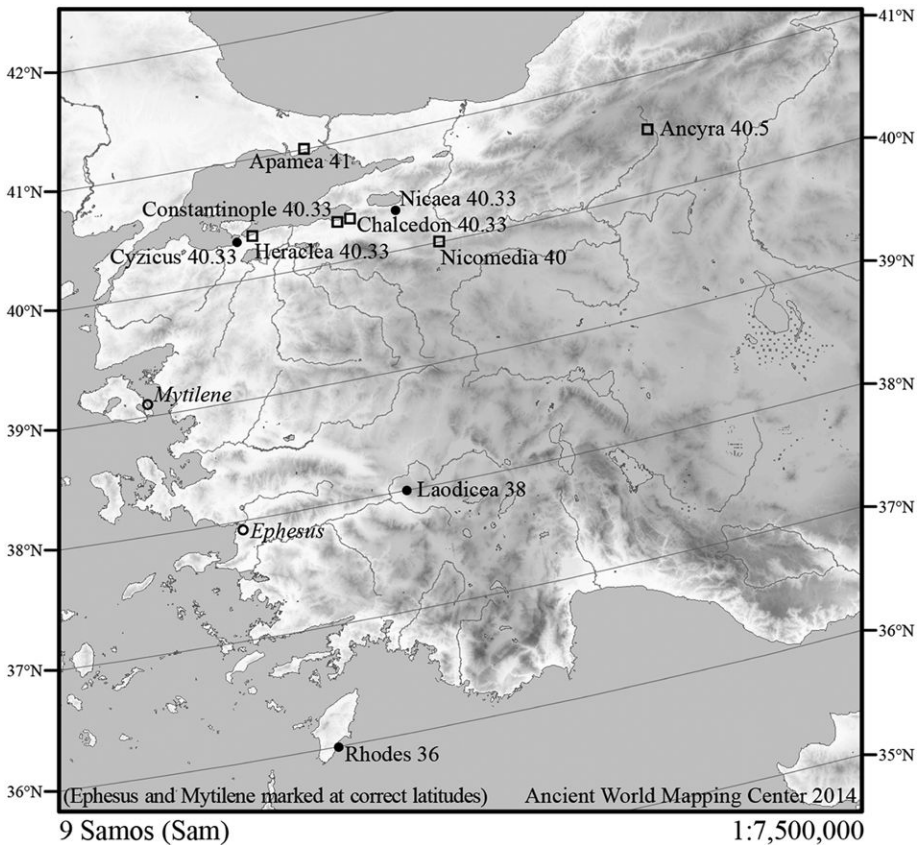
Photo: Karlheinz Schaldach.

are spaced out evenly and well apart (Map 2.7). A line (overlooked by Tölle) was drawn under both in every instance presumably, although now visible only under some (Miletus, for example). The names are written from just beyond a circle drawn quite close to the center of the disc. Near the rim, a further circle separates each name from its figure.

The latitude figures are inscribed so close to the rim that their legibility has suffered. Even so, there seems little doubt that the second of the letters for Laodicea was H. However, Tölle's reading $\Lambda\Theta$ for the latitude of Ancyra has to be queried: I read it as M followed by a raised C, the typical symbol for half. A further cause for query is Tölle's reading ΛH as the letters of the latitude for MIAIT. Instead, the sloping strokes here—three, without any separation—appear to make up a single letter only, which first does indeed take the form of Λ , or even of M, but then is not finished off, such that the engraver's intention remains unclear. In addition, Tölle's assumption that the name is Miletus misspelled seems open to doubt. If the sequence of names is deliberate (see further Chapter 3 section 6 and Map 3.2), Mytilene can be considered more likely although misspelled too. Its first vowel is often spelled with an iota rather than an upsilon, and the transposition of T and Λ is a commonplace slip: compare

ILATIA for Italia on no. 7 (Oxford). For either Miletus or Mytilene, a latitude in the high 30s, or even 40, might be expected; the latter would be written M, the former ΛΖ, ΛΗ or ΛΘ (37, 38, 39). I cannot discern the start of any such second letter in the figure as it survives here.

Tölle took note of a stroke (variously upright or sloping) that she discerned following the M in the latitudes for Nicaea, Heraclea, Constantinople, and Nicomedia. Although she rightly acknowledged that this stroke—with no sign of a crossbar—could hardly be read as the start of an A (to raise the latitude to 41 from 40), an alternative explanation eluded her. I do not discern such a stroke following the M for the latitude of Nicomedia; however, I do see it in the other three instances, and also in those of Chalcedon and Cyzicus. Among all these five, the length and placement of the stroke (sometimes raised) vary. Even so, they all seem most likely to signify a fraction of a degree. As noted at the



MAP 2.7 Samos, no. 9.

Ancient World Mapping Center.

start of this chapter, one-third is perhaps more probable and thus my preference for the listing.

For discussion of which cities may be meant by Apamea, Heraclea, and Laodicea, see Chapter 3 section 4.

Dating No earlier than the foundation of Constantinople in the 320s.

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IG XII 6, 2 (2003) no. 973 (by Klaus Hallof, with incidental comparison to Asterix).¹³

Karlheinz Schaldach and Ortwin Feistel, "Eine tragbare Reiseuhr aus der Spätantike,"

Chronométrophilie 72 (2012): 71–82 [n.b. The caption for their Abb. 6 mistakenly represents it as a drawing of the obverse of this sundial; rather, the drawing reproduced is Buchner's model of an "Urtyp"; see Buchner (1971), 470 and Tafel XII.].

Winter (2013), 545–46 (Samos no. 4).

10 Time Museum (Tim)

Privately owned

Material Bronze

Dimensions Diameter 12 cm, depth 3 mm

Provenance and ownership Nothing is known before the sundial was offered for sale in 1977 with four surveying instruments; no information about provenance was forthcoming. All five items (Fig. 2.35) are reckoned to have been found together (Brieux 1977). They were purchased and displayed by the Time Museum, Rockford, Illinois (inv. no. 1417), until its closure and dispersal (see Chapter 5 note 2). When offered as a single lot at Sotheby's (New York) in 2004, the five instruments were purchased for \$30,000 by an individual who remains anonymous (Sotheby's 2004, 212–13).

Description The detailed account to be furnished by Anthony Turner in the projected Time Museum catalog volume 1.2 *Time-measuring Instruments: Sun-dials and Nocturnals* never appeared (Field and Wright 1985, 106 n. 17), although there is a brief mention in a later book by Turner (1994, 61). Judith Field offers the fullest discussion (1990, 120–22, 128–33). Only a disc survives. Along one quadrant of the **obverse** rim (Fig. 2.36), latitude figures up to 90 are

13. Note the use of a wristwatch sundial by a soccer referee in René Goscinny and Albert Uderzo, *Astérix chez les Bretons* (1966), 42, and its many translations (English: *Asterix in Britain*).

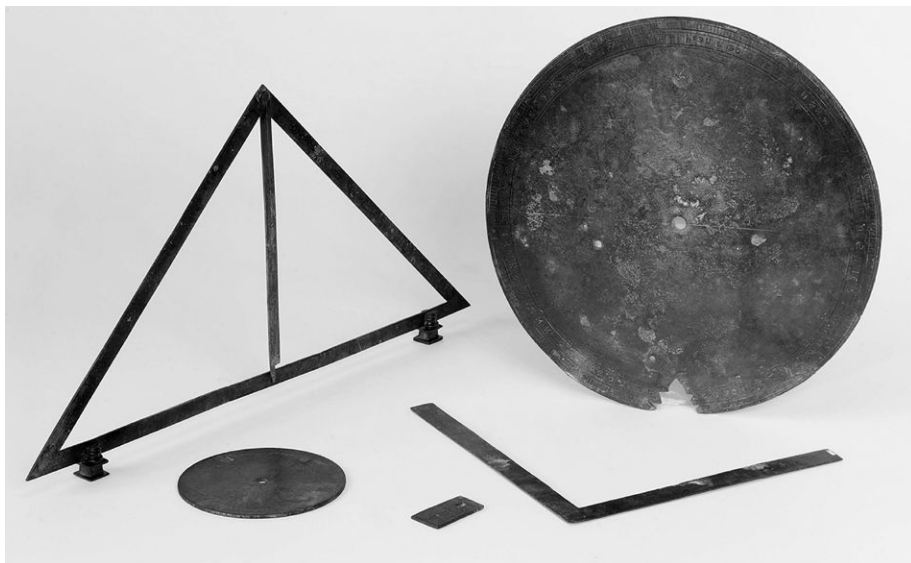


FIGURE 2.35 Time Museum, no. 10 (front, left), and the four bronze instruments discovered with it: (rear, right) plate, possibly of a sighting device (*dioptra*); (rear, left) triangular level mounted on two square pedestals and with a cursor suspended from its apex; (front, center) sighting vane with two holes; (front, right) set square.

Photo: Sotheby's, New York.



FIGURE 2.36 Time Museum: obverse.

Photo: Sotheby's, New York.

marked off in single degrees and inscribed in Greek figures every 5 degrees clockwise (5, 10, 15, 20, 25, 30, etc.). A punch mark has been made at latitude 43, no doubt because this is the figure recorded for Constantinople (and Cappadocia) on the reverse. At either end of a diameter line a fan-shaped network of lines is inscribed, with the names of the months in the Julian calendar abbreviated in Greek (six on each scale). The abbreviations at the end nearer the latitude figures are listed first; in those for May, October, and December, the final letters are misspellings:

ΙΑ	ΦΕ	ΜΑΡ	ΑΠΡ	ΜΑΡ	ΙΟ
ΙΟ	ΑΓΟ	ΣΕΠ	ΟΚΠ	ΝΟ	ΔΟ

On either side of these networks two further, seemingly identical, fans are laid out; the arc of each is divided by successive lines marked Α, Β, Γ, Δ, Ε at increasing intervals. At the top of the lefthand arc a rough square patch has been created; a corresponding square of raised surface appears at the top of the righthand arc. The two further fans were conceivably intended as a means of

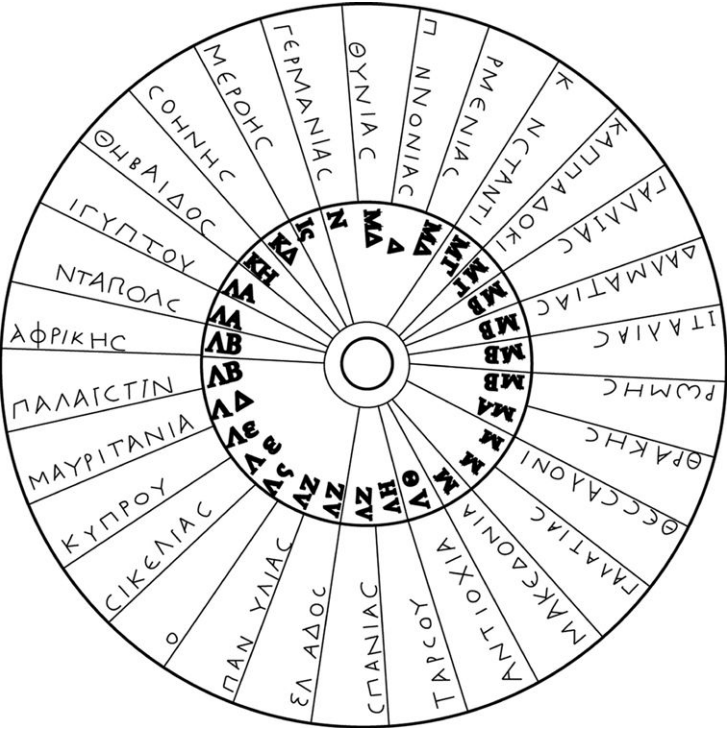


FIGURE 2.37 Time Museum: reverse drawing.
Ancient World Mapping Center.

replicating on the sundial's flat surface the record of time visible along the (now lost) hour scale.

On the **reverse** (Fig. 2.38), thirty names—all starting from the rim—were inscribed in Greek, each with a corresponding latitude figure (Map 2.8). Throughout, many letters (two of them serving as figures), including most of one name, are illegible; however, for the most part their restoration is uncontroversial (Fig. 2.37). A line separates each name and figure from the next. A circle separates each name from its figure.

The name at latitude 36—for which only the second (?), barely legible letter survives—remains beyond recovery. Given the strong correspondence between the names and their latitude figures on this sundial and the British Museum sundial no. 15 (see further Chapter 4 section 1), Coele (Syria) could plausibly be conjectured. However, Rhodes should not be ruled out; the second letter of both is O: ΚΟΥΛΗ or ΚΟΙΛΗ, ΡΟΔΟΣ.

ΜΕΡΟΗΣ	ΙΣ	Meroe	16	16 25	17 00
ΣΟΗΝΗΣ	ΚΔ	Syene	24	23 50	24 00
ΘΗΒΑΙΔΟΣ	ΚΗ	Thebais	28	23 50–28 00	~24–28
[.]ΙΓΥΠΤΟΥ	ΛΑ	Egypt	31	23 50–31 20	~24–31
[..]ΝΤΑΠΟΛΣ	ΛΑ	Pentapol-is/-eis	31	31 00–31 40	~32–33
ΑΦΡΙΚΗΣ	ΛΒ	Africa	32	25 00–33 20	~south–37
ΠΑΛΑΙΣΤΙΝ	ΛΒ	Palestine	32	30 40–32 30	~31–33
ΜΑΥΡΙΤΑΝΙΑ	ΛΔ	Mauretania	34	25 00–36 00	~south–36
ΚΥΠΡΟΥ	ΛΕ	Cyprus	35	34 40–36 10	34 40–35 40
ΣΙΚΕΛΙΑΣ	ΛΕ	Sicily	35	36 00–38 30	36 40–38 20
[.]Ο[<i>nothing further legible</i>]	ΛΣ	[Coele (Syria)?] (see comment below)	36		
ΠΑΝ[.]ΥΛΙΑΣ	ΛΖ	Pamphylia	37	36 30–38 30	~37–38
ΕΛ[.]ΑΔΟΣ	ΛΖ	Hellas	37	34 00–41 30	~36–41
ΣΠΑΝΙΑΣ	ΛΖ	Spain	37	36 00–46 00	~36–44
ΤΑΡΣΟΥ	ΛΗ	Tarsus	38	36 50	36 50
ΑΝΤΙΟΧΙΑ	ΛΘ	Antioch (<i>Pisidia?</i>)	39	39 15 (38 50)	38 20
ΜΑΚΕΔΟΝΙΑ	Μ	Macedonia	40	38 30–42 00	~39–42
ΓΑΛΑΤΙΑΣ	Μ	Galatia	40	38 40–44 30	~38–42
ΘΕΣΣΑΛΟΝΙ	Μ	Thessalonica	40	40 20	40 40
ΘΡΑΚΗΣ	ΜΑ	Thrace	41	40 40–44 40	~40–43
ΡΩΜΗΣ	ΜΒ	Rome	42	41 40	41 50
ΙΤΑΛΙΑΣ	ΜΒ	Italy	42	38 00–45 00	~38–46
ΔΑΛΜΑΤΙΑΣ	ΜΒ	Dalmatia	42	41 00–45 00	~42–45
ΓΑΛΛΙΑΣ	ΜΒ	Gallia	42	42 10–53 30	~43–51
ΚΑΠΠΑΔΟΚΙΑ	ΜΓ	Cappadocia	43	37 30–43 00	~38–41
Κ[.]ΝΣΤΑΝΤΙ	ΜΓ	Constantinople	43	43 05	41 00
[.]ΡΜΕΝΙΑΣ	ΜΔ	Armenia	44	38 00–44 30	~38–41
Π[.]ΝΝΟΝΙΑΣ	[.]Δ	Pannonia	44?	44 30–48 00	~45–48
[..]ΘΥΝΙΑΣ	ΜΔ	Bithynia	44	41 15–43 30	~40–42
ΓΕΡΜΑΝΙΑΣ	Ν[.]?	Germania	50[+?]	45 30–56 00	~47–54



FIGURE 2.38 Time Museum: reverse.

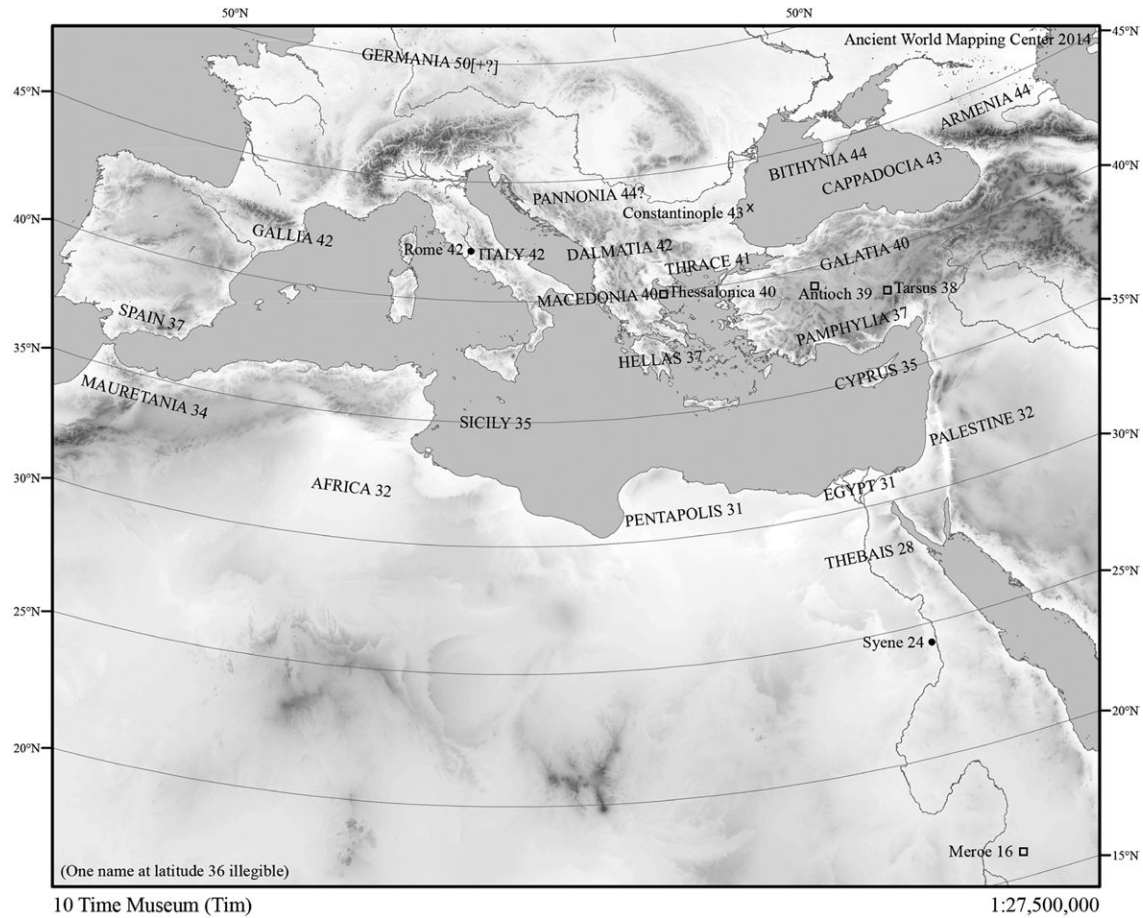
Photo: Sotheby's New York.

For discussion of which city named Antioch may be meant, see Chapter 3 section 4.

Dating No earlier than the foundation of Constantinople in the 320s.

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 A. J. Turner, *Mathematical Instruments in Antiquity and the Middle Ages: An Introduction* (1994), 61.
 [Sotheby's], *Masterpieces from the Time Museum part 4 volume II Chronometers and Scientific Instruments*, New York, Oct. 13 & 14, 2004, lot 734, pp. 212–13.
 Winter (2013), 612–13 (Fundort unbekannt no. 14).



MAP 2.8 Time Museum, no. 10.

Ancient World Mapping Center.

II Philippi (Phi)

Archaeological Museum, Philippi, Greece, inv. no. Δ 572

Material Bronze

Dimensions Three rings:

Outer: exterior diameter 7.25 cm, interior diameter 6.49 cm, depth 3.8 mm, breadth 5 mm

Center, comprising two half-rings: exterior diameter 6.45 cm, interior diameter 5.72 cm, depth 3.6 mm, breadth 5 mm

Inner: exterior diameter 5.7 cm, interior diameter 5.15 cm, depth 2.8 mm, breadth 5 mm

Provenance and ownership The sundial was found at Philippi (*BAtlas* 51 C2) in 1965 during excavations of a sewer to the east of the Octagon area close to the Via Egnatia in the center of the ancient city (Gounaris and Gounaris 2004, 23 [plan], 75). It was published by Georgios Gounaris in 1978 (in Greek; French translation 1980), and is displayed in the Philippi Archaeological Museum.

Description The sundial comprises three rings (Figs. 2.39 and 2.40). Its design is remarkable: it matches that of the “astronomical ring dials” known from the



FIGURE 2.39 Philippi, no. II: open position.

Photo: Archaeological Museum, Philippi, Greece, and Lee Brice.

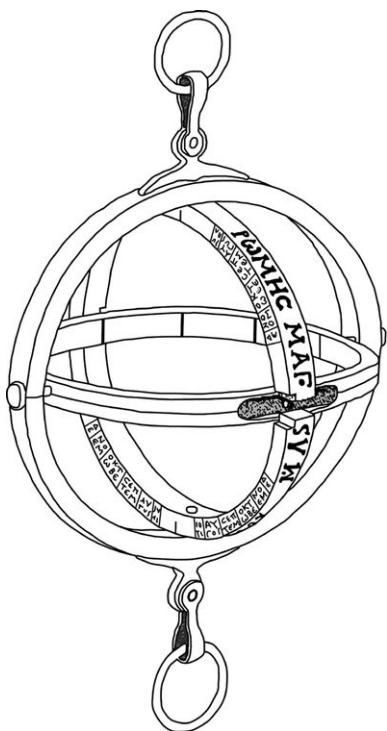


FIGURE 2.40 Philippi: open position drawing.
Ancient World Mapping Center.

Renaissance onward and not previously thought to have had any forerunners (Turner 1989, 311). The center and inner rings can fit within the outer ring so that the three lie flat together: it was in this closed position that the ring emerged from the sewer (Figs. 2.41 and 2.42). At both top and bottom the **outer ring** has an attachment rising to a circle with a small hole, into which a clasp is pinned; through each clasp there runs a ring, which allows the dial to be suspended in two opposite directions.

The **center ring** comprises two half-rings, each attached to the outer by a pivot, which allows it to be swung round as required. On the top of each quadrant of the half-rings is inscribed in Greek the name of a city with its latitude figure, four in all (Map 2.9). Observe that the style is inconsistent, however. The figures for Alexandria (Fig. 2.43) and Rhodes (Fig. 2.44) are preceded by $\dot{M}$ = μοίραι (degrees), but there is no such initial $\dot{M}$ for Rome (Fig. 2.45), while the $\dot{M}\epsilon$ for Vienne's figure must in fact be a slip for $\dot{M}\dot{M}\epsilon$ (Fig. 2.46):

ΑΛΕΞΑΝ ΜΑΑ	Alexandria	31°	31 00	31 10
ΡΟΔΟΥ ΜΑΣ	Rhodes	36°	36 00	36 25
ΡΩΜΗC ΜΑΓ	Rome	41.66	41 40	41 50
ΟΥΙΕΝΝ ΜΕ	Vienne	45°	45 00	45 30



FIGURE 2.41 Philippi: closed position.

Photo: Archaeological Museum, Philippi, and Lee Brice.

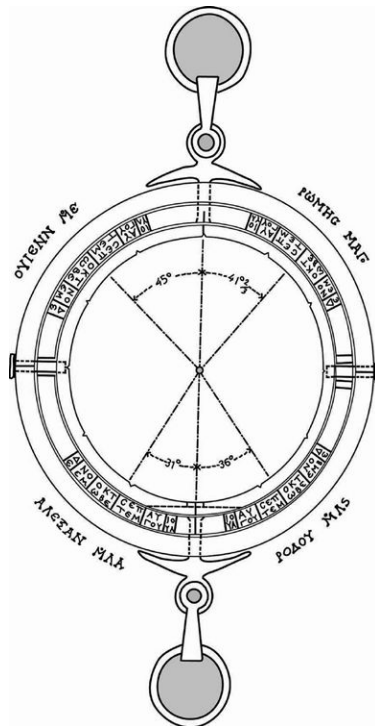


FIGURE 2.42 Philippi: closed position drawing.

Ancient World Mapping Center.



FIGURE 2.43 Philippi: Alexandria quadrant.

Photo: Archaeological Museum, Philippi, and Lee Brice.



FIGURE 2.44 Philippi: Rhodes quadrant.

Photo: Archaeological Museum, Philippi, and Lee Brice.



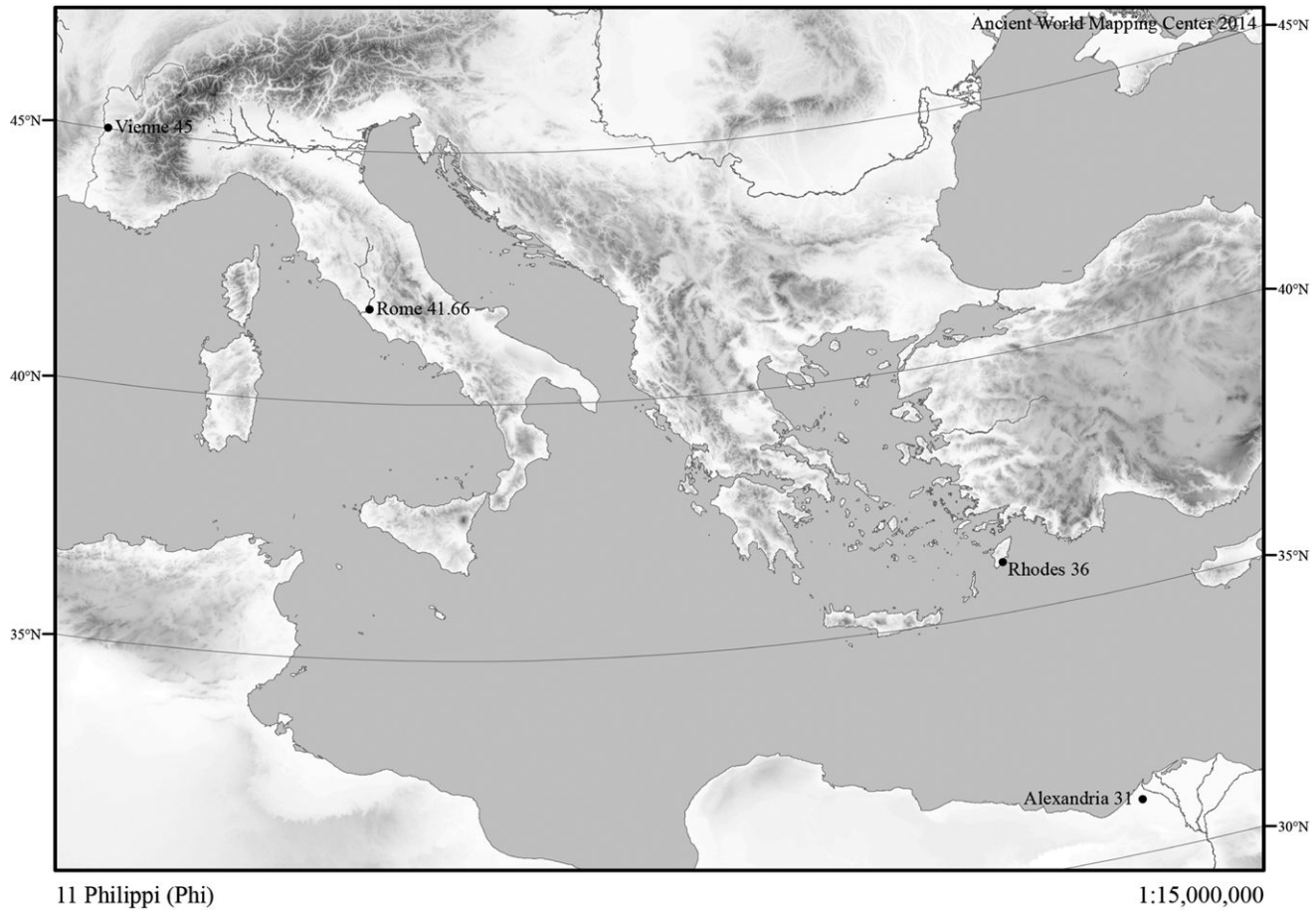
FIGURE 2.45 Philippi: Rome quadrant.

Photo: Archaeological Museum, Philippi, and Lee Brice.



FIGURE 2.46 Philippi: Vienne quadrant.

Photo: Archaeological Museum, Philippi, and Lee Brice.



Ancient World Mapping Center.

On each side of each quadrant are inscribed in Greek the abbreviated names of six months of the Julian calendar in two lines with six vertical dividers. Below Rhodes and Vienne both sets of months appear as presented here. Below Alexandria and Rome the order of months in each set is reversed (but no letters are reversed):

ΙΑ	ΦΕΒ	ΜΑΡ	ΑΠΡΙ	ΜΑΙ	ΙΟ
ΝΟ	ΡΑΡ	ΤΙΟ	ΛΙΟ	Ο	ΥΝ
ΙΟ	ΑΥ	ΣΕΠ	ΟΚΤ	ΝΟ	Δ
ΛΥ	ΓΟΥ	ΤΕΜ	ΩΒΕ	ΕΜ	Ε

The **inner ring** is held in place by two pivots that are driven through the outer ring and separate the two half-rings of the center ring. On the inside of the inner ring are marked twelve vertical divisions—for hours—at equal intervals. On the outside of this ring is a slit pierced in the center by a small hole. Rays of the sun passing through this hole mark the time when the appropriate settings for month and latitude have been made.

Dating The sundial was found in an area not built up until the first half of the fourth century CE, so it could only have been abandoned in the sewer from that period onward. Whether the sundial was made earlier (and, if so, how long before) is also uncertain, although Gounaris's comparison of the style of the lettering with that of other inscriptions indicated to him manufacture between around 250 and 350 (1980, 13–17).

Bibliography

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 = Georgios Gounaris, “Anneau astronomique solaire portative antique, découvert à Philippes,” *Annali dell' Istituto e Museo di Storia della Scienza di Firenze* 5.2 (1980): 3–18.
 Turner (1989), 311.
 Georgios Gounaris and Emmanuela Gounaris, Φίλιπποι: Αρχαιολογικὸς οδηγὸς (2004).
 Winter (2013), 479–81 (Philippi no. 2).

12 Science Museum, London (Sci)

London, Science Museum, inv. no. 1983-1393

Material Low-zinc brass, with traces of tin and lead

Dimensions Diameter of the surviving disc 13.5 cm; depth of the entire disc component of the instrument 1.5 cm (inferred from the design of the suspension arm to fit over this component)

Provenance and ownership The four surviving components were acquired by the Science Museum, London, from a private collector who claimed to have purchased them in Lebanon, but could offer no further information (Field and Wright 1985, 99).

Description The four components can reasonably be reckoned to have all been parts of the same sundial, and were published as such by Judith Field and Michael Wright (1985) in the following terms. By no means all their many illustrations referred to are reproduced here:

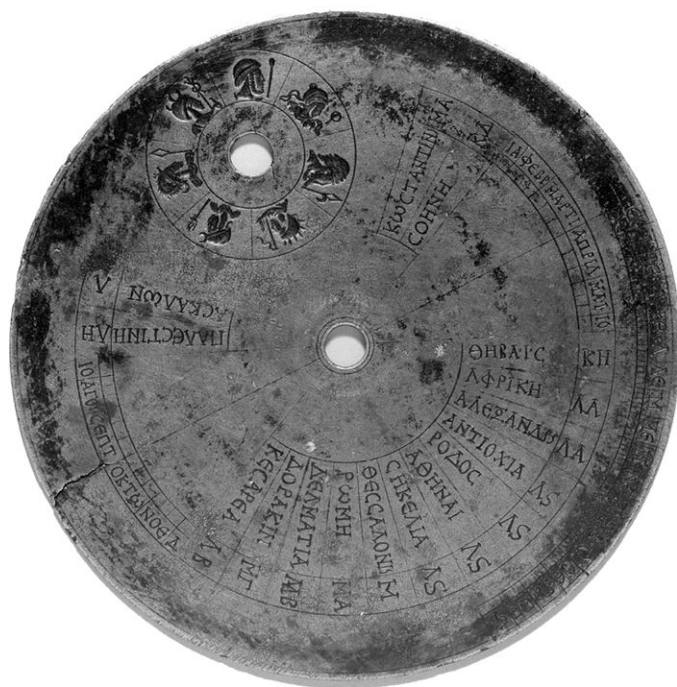


FIGURE 2.47 Science Museum, no. 12: disc obverse.

Photo: Science Museum/Science & Society Picture Library, London.

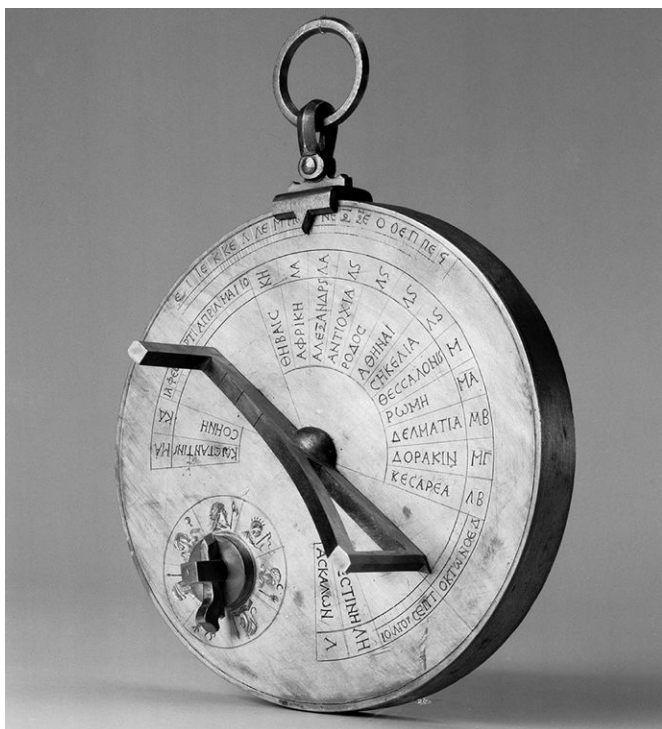


FIGURE 2.48 Science Museum: reconstruction by the Science Museum.

Photo: Science Museum/Science & Society Picture Library.



FIGURE 2.49 Science Museum: suspension arm and ring.

Photo: Science Museum/Science & Society Picture Library.

1. Disc with two holes, one at the center, the other fairly close to the rim and surrounded by seven heads representing the “rulers” of the days of the week (Sun, Moon, Mars, Mercury, Jupiter, Venus, Saturn). Obverse: Plates 1(a) (photograph; Fig. 2.47 here) and 7 (close-up photograph of the heads); Figure 1 (redrawn as Fig. 2.50 here). Reverse (blank surface): Plate 1(b) (photograph).
2. Suspension arm and ring: Plates 2(a), (b) (photographs, Fig. 2.49 here); Figure 2 (drawings).
3. Arbor (spindle) with seven-lobed ratchet and two gear pinions of seven and ten teeth respectively: Plates 3(a), (b) (photographs); Figure 3 (drawings).
4. Arbor, which bears a Moon disc with fifty-nine teeth around its outer edge, where successive sequences of numbers (1–29, 1–30, presumably for two lunations of twenty-nine and thirty days) are marked in Greek letters all around. Attached to the back of the disc are first a broad washer and then a gear pinion with nineteen teeth: Plates 4(a), (b) (photographs); Figure 4 (drawings).

This instrument—reconstructed in Figure 2.48—is unique among those currently known in offering its user two distinct devices: a geared calendar and

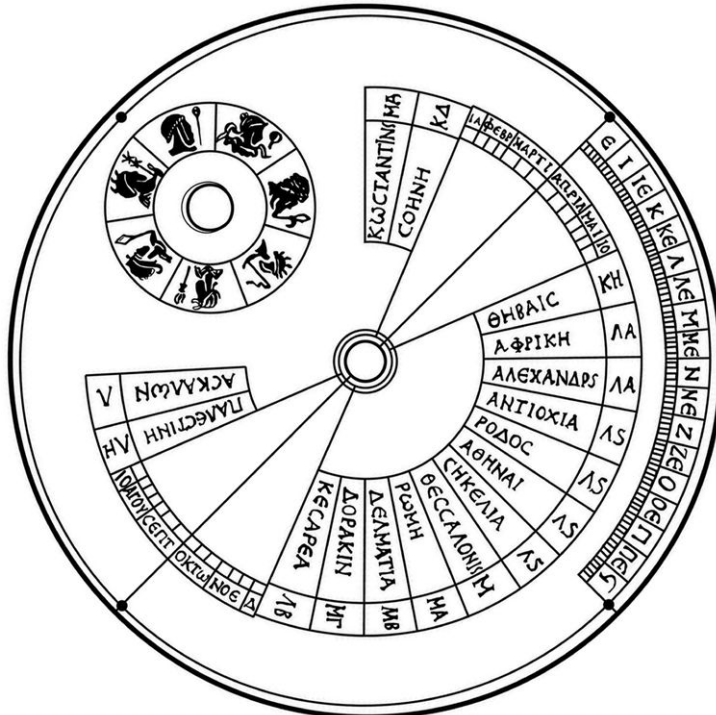


FIGURE 2.50 Science Museum: disc obverse drawing.

a portable sundial. It was the components needed for this dual function that must have made the instrument considerably deeper and heavier than the comparable known sundials. The workings of the calendar—so far as they can be reconstructed, when without doubt there was originally further wheel work now lost—are discussed in detail by Field and Wright (1985), Field (1990, 124–27), and Wright (1990), and summarized by James Evans (1998, 82–83, fig. 2.10).

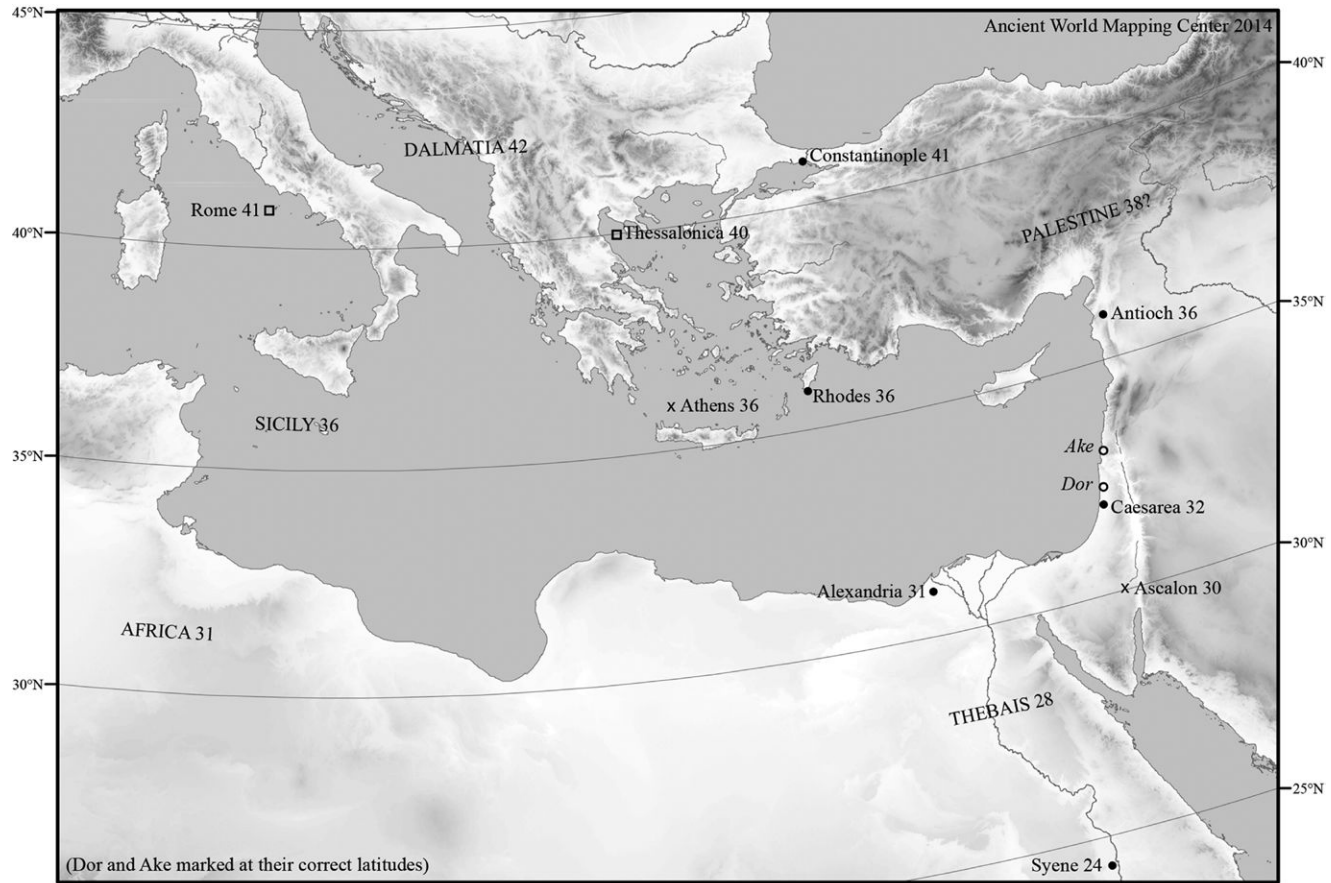
The **arm** at its lower end forms a circle that matches in diameter the central hole of the disc. The upper end of the arm is continued to fit over the entire disc component of the instrument, and ends in a triangular pointer, which can be moved in particular along the rim of the obverse where latitudes are marked. Attached at the upper end of the arm is a ring for suspending the sundial.

Along one quadrant of the **obverse** rim, latitude figures up to 90 are marked off and inscribed in Greek figures every 5 degrees clockwise, with single-degree intervals also being marked. At either end of a diameter line a fan-shaped network of lines is inscribed, with the names of the months in the Julian calendar abbreviated in Greek (six on each scale) and—for most months—ten-day intervals marked out. The abbreviations at the end nearer the latitude figures are listed first:

ΙΑ	ΦΕΒΡ	ΜΑΡΤΙ	ΑΠΡΙΛ	ΜΑΙ	ΙΟ
ΙΟ	ΑΓΟΥ	ΣΕΠΤ	ΟΚΤΩ	ΝΟΕ	Δ

Also on the obverse (untypically), sixteen names are inscribed in Greek, each with a corresponding latitude figure (Map 2.10). The names run outward from just beyond a circle drawn quite close to the center of the disc; a further circle

ΚΩΣΤΑΝΤΙΝΟΣ	ΜΑ	Constantinople	41	43 05	41 00
ΣΟΥΗΝΗ	ΚΔ	Syene	24	23 50	24 00
<i>(break for network)</i>					
ΘΗΒΑΙΣ	ΚΗ	Thebais	28	23 50–28 00	~24–28
ΑΦΡΙΚΗ	ΛΑ	Africa	31	25 00–33 20	~south–37
ΑΛΕΞΑΝΔΡΟΣ	ΛΑ	Alexandria	31	31 00	31 10
ΑΝΤΙΟΧΙΑ	ΛΣ	Antioch (<i>Syria?</i>)	36	35 30	36 10
ΡΟΔΟΣ	ΛΣ	Rhodes	36	36 00	36 25
ΑΘΗΝΑΙ	ΛΣ	Athens	36	37 15	38 00
ΣΙΚΕΛΙΑ	ΛΣ	Sicily	36	36 00–38 30	36 40–38 20
ΘΕΣΣΑΛΟΝΙΚΟΣ	Μ	Thessalonica	40	40 20	40 40
ΡΩΜΗ	ΜΑ	Rome	41	41 40	41 50
ΔΕΛΜΑΤΙΑ	ΜΒ	Dalmatia	42	41 00–45 00	~42–45
ΔΟΡΑΚΙΝ	ΜΓ	Dor(a) [and] Ake? (<i>see comment below</i>)	43*	32 40 <i>and</i> 33 00	32 40 <i>and</i> 32 55
ΚΕΣΑΡΕΑ	ΛΒ	Caesarea (<i>Palestine?</i>)	32	32 30	32 30
<i>(break for network)</i>					
ΠΑΛΕΣΤΙΝΗ	ΛΗ	Palestine	38*	30 40–32 30	~31–33
ΑΣΚΑΛΩΝ	Λ	Ascalon	30	31 40	31 40



12 Science Museum, London (Sci)

1:17,500,000

MAP 2.10 Science Museum, no. 12.

Ancient World Mapping Center.

separates each name from its figure. A line separates each name and figure from the next. The first two names (as listed above) are placed to the left of the fan-shaped network at the end farther from the latitude figures; the next twelve then follow round clockwise from its right until the end nearer the latitude figures is reached; the final two names of the sixteen are placed beyond this end.

Wright (1990, 72) observes that the first figure of the latitude for Dalmatia was initially written Λ and then altered to M (resulting in a change from 32 to 42). In addition, Field and Wright (1985, 111) suggest convincingly that latitude ΛH (38) for Palestine is an uncorrected slip for ΛB (32). To add to the sense of confusion, it is conceivable that the figure $M\Gamma$ (43) for the puzzling name $\Delta OPAKIN$ is a slip for $\Lambda\Gamma$ (33).

However, the argument advanced by Field and Wright (1985, 110–12) to interpret $\Delta OPAKIN$ as Doclea is not persuasive (see Dating below). To read it as Dor(a) ($\Delta\Omega PA$) [and] Ake (AKH), as I propose, can likewise only be conjecture, and it is true that in no other lists do two names share the same line. Even so, the expedient seems natural enough. The compiler of this list had some concern for Palestine and its coast, and could well have realized the opportunity to use only one line for two cities there, each with a very short name and situated not far apart (*BAtlas* 69 A4–B4; the Semitic name Ake was not forgotten after the city received a Greek name, Ptolemais). Other lists provide instances of the compiler including two locations where strictly speaking one would have sufficed (see Chapter 4 section 2).

Dating No earlier than the foundation of Constantinople in the 320s. The argument advanced by Field and Wright (1985, 110–12) to interpret the name $\Delta OPAKIN$ as Doclea (*BAtlas* 49 B1), capital of the Late Antique province Praevalitana, and to infer from it that the sundial is likely to have been made between the late fifth and late sixth centuries, rests on too insecure a base. Moreover, as they acknowledge, if the latitude figure (43) for this name is to be regarded as free of error, then there arises the puzzle that the maker of the list should envisage Dalmatia (with a lower latitude figure, 42) to the south rather than to the north. My own previous conjecture, Dyrrhachium (Talbert 2010b, 266), creates the same difficulty, and I now abandon it.

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James Evans (1998), 82–83.

Winter (2013), 615–17 (Fundort unbekannt no. 16).

13 Vignacourt/Berteaucourt-les-Dames (Vig)

Musée de Picardie, Amiens, France, inv. no. MP 90.8.1

Material Bronze

Dimensions Diameter 10.4 cm

Provenance and ownership Stray surface find made during investigation of a Gallo-Roman villa site first identified in 1968; subsequently acquired by the Musée de Picardie (Ben Redjeb 2012). The site is approximately 12 km north of Amiens (ancient Samarobriua Ambianorum, *BAtlas* 11 C3), where the *communes* Vignacourt and Berteaucourt-les-Dames adjoin.

Description A reexamination by Christine Hoët-van Cauwenberghe (2012b, esp. Tableau 6 and figs. 5 and 6) supersedes the initial brief—and not wholly accurate—publication by Jean-Luc Massy (1985). Only a disc survives, and it has become warped. It is impossible to read anything on the **obverse** (Figs. 2.51 and 2.52). On a limited part of the **reverse** (Figs. 2.53 and 2.54), seven transverse curved lines are drawn with a Latin abbreviation for a month or solstice at each end (on the rim of the disc, and close to the center):



FIGURE 2.51 Vignacourt/Berteaucourt-les-Dames, no. 13: obverse.

Photo: Musée de Picardie, and Gauthier Gillmann.

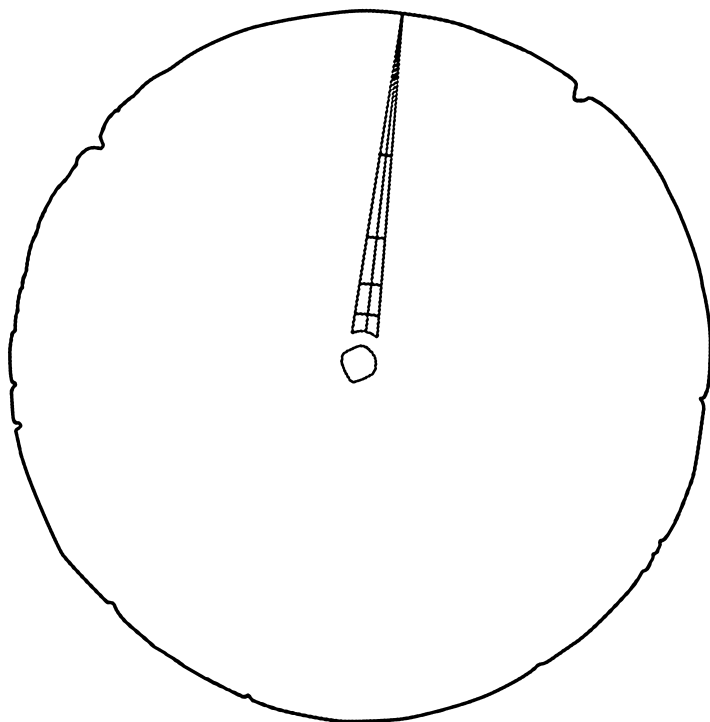


FIGURE 2.52 Vignacourt/Berteaucourt-les-Dames: obverse drawing.
Christine Hoët-van Cauwenberghe in *Revue du Nord* 398 (2012): 107, fig. 6b.



FIGURE 2.53 Vignacourt/Berteaucourt-les-Dames: reverse.
Photo: Musée de Picardie, and Hugo Maertens.

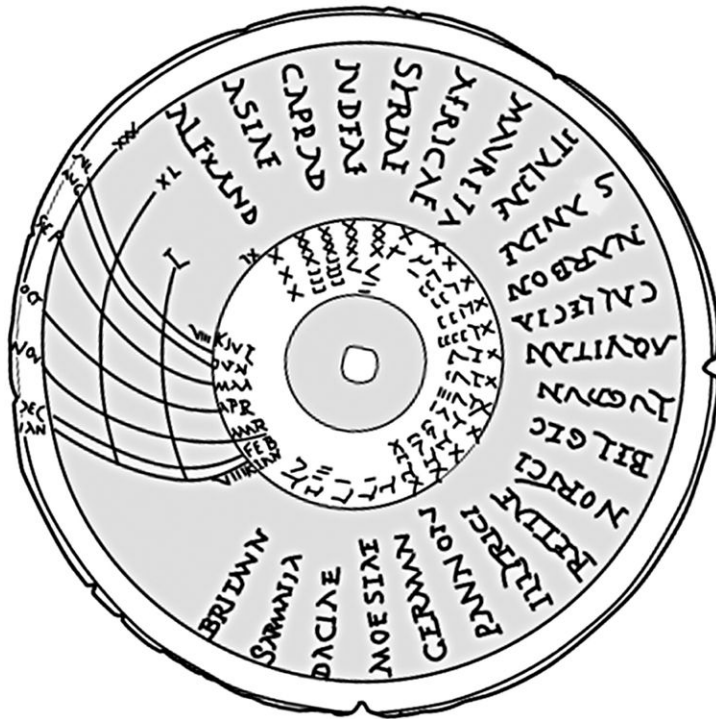


FIGURE 2.54 Vignacourt/Berteaucourt-les-Dames: reverse drawing.

Christine Hoët-van Cauwenbergh in *Revue du Nord* 398 (2012): 107, fig. 6a.

IVL	VIII K IVL
AVG	IVN
SEP	MAI
OCT	APR
NOV	MAR
DEC	FEB
IAN	VIII K IAN

There are two lines describing a full circle where the seven curved lines begin and end. The two are marked XXX (near the rim) and LX respectively; in between, preserving equal intervals, two further lines are drawn for a limited part of the circle and marked XL and L. These four figures (for latitudes 30, 40, 50, 60) are placed one below the next between IVL VIII K IVL to the left and ALEXAND XXX to the right. For discussion of the possible purpose of this part of the reverse, see Savoie and Goutaudier (2012) and Chapter 4 section 3.

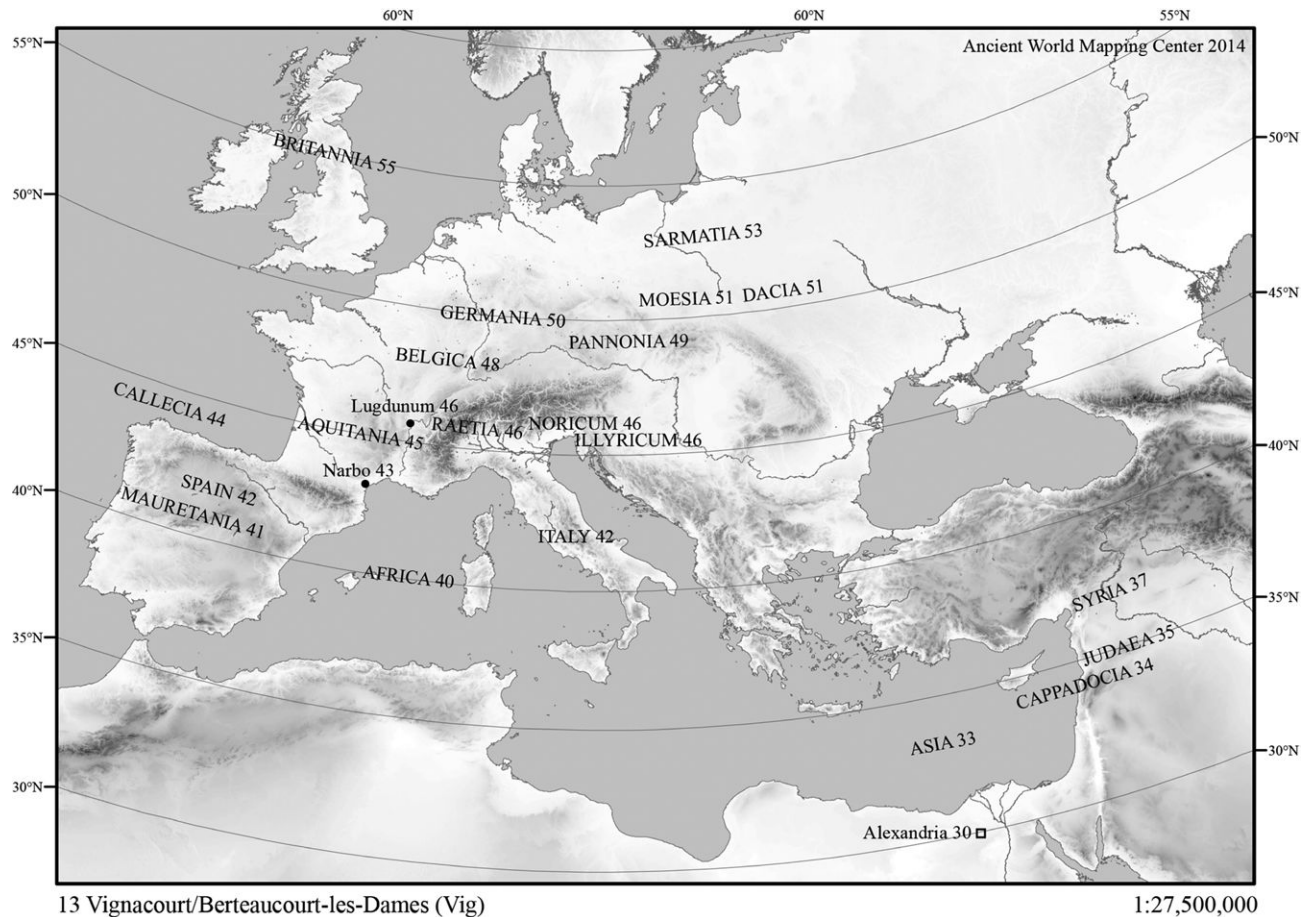
The remainder of the reverse is occupied by twenty-three names in Latin, each with a corresponding latitude figure (Map 2.11). The names start from the rim, with the figures toward the center; names and figures are separated by the circle marked LX mentioned above.

ALEXAND	XXX	Alexandria	30	31 00	31 10
ASIAE	XXXIII	Asia	33	35 30–41 30	~36–40
CAPPAD	XXXVIII	Cappadocia	34	37 30–43 00	~38–41
IVDEAE	XXXV	Judaea	35	30 40–32 30	~31–33
SYRIAE	XXXVII	Syria	37	31 00–38 00	~32–37
AFRICAЕ	XL	Africa	40	25 00–33 20	~south–37
MAVRETA	XLI	Mauretania	41	25 00–36 00	~south–36
ITALIAE	XLII	Italy	42	38 00–45 00	~38–46
S[.]ANIAE	XLII	Spain	42	36 00–46 00	~36–44
NARBON	XLIII	Narbon-is/-ensis	43	43 (15)	43 10
CALLECIA	XLVIII	Callectia	44	41 50–46 00	~41–44
AQVITAN	XLV	Aquitania	45	43 00–48 30	~43–47
LVGDVN	XLVI	Lugdun-um/-ensis	46	45 50	45 45
BELGIC	XLVIII	Belgica	48	45 10–54 00	~47–52
NORICI	XLVI	Noricum	46	45 20–47 00	~46–48
RETIAE	XLVI	Raetia	46	45 20–47 20	~46–49
ILLYRICI	XLVI	Illyricum	46	41 00–45 00	~41–46
PANNON	XLIX	Pannonia	49	44 30–48 00	~45–48
GERMAN	L	Germania	50	45 30–56 00	~47–54
MOESIAE	LI	Moesia	51	42 00–48 30	~42–46
DACIAE	LI	Dacia	51	43 30–48 30	~44–47
SARMATIA	LIII	Sarmatia	53	48 30–north	~47–north
BRITANN	LV	Britannia	55	51 30–59 00	~50–59

Dating Uncertain. Massy (1985, 482) was surely too bold in proposing a late-second-century date on the grounds that SARMATIA may be thought to signify one of the two new provinces that Marcus Aurelius aimed—in vain—to establish (along with Marcomannia) north of the Danube in the middle to late 170s, according to *Historia Augusta*, *Marcus Antoninus* 24.5, 27.10 (cf. CAH² vol. 11, 176).

Bibliography

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- Denis Savoie and Marc Goutaudier, “Les disques de Berteaucourt-les-Dames et de Mérida: méridiennes portatives ou indicateurs de latitude?” *Revue du Nord. Archéologie* 398 (2012): 115–19.
- Overlooked by Winter (2013).



MAP 2.II Vignacourt/Berteaucourt-les-Dames, no. 13.
Ancient World Mapping Center.

14 Mérida (Mér)

Museo Nacional de Arte Romano, Mérida, Spain, inv. no. CE37086

Material Bronze

Dimensions Diameter 13 cm, depth 4 mm

Provenance and ownership Random find somewhere in the Mérida area (ancient Emerita Augusta, *BAtlas* 26 D3), presented to the museum in the early 1990s

Description The sole publication is by Javier Arce (1997); my listing of the names and spacing of the figures reflects a fresh reading of the reverse. Only a disc survives, and it has become warped and chipped. The hole at the center has been crudely enlarged; a further, very small hole has been pierced near the edge immediately above the first two letters of MOESIA. Severe corrosion makes it impossible to read anything on the **obverse**. On a limited part of the **reverse**, toward the rim, six transverse curved lines (incomplete) are visible, bounded by two fragmentary indicators in Latin: VII IAN and V I IVL: for these lines and their possible purpose, compare the Vignacourt sundial (no. 13) with discussion by Savoie and Goutaudier (2012) and further in Chapter 4 section 3. The remainder of the reverse is occupied by nineteen names in Latin, each with a corresponding latitude figure (Map 2.12). The names are well spaced out, and start from the rim, with the figures toward the center. Each name and



FIGURE 2.55 Mérida: reverse overview.

Inv. CE37086, photo Museo Nacional de Arte Romano, Mérida, Spain, and Jonathan Edmondson.



FIGURE 2.57 Mérida: Alexandria (bottom left) to Sarmatia.

Inv. CE37o86, photo Museo Nacional de Arte Romano, Mérida, and Jonathan Edmondson.



FIGURE 2.58 Mérida: Moesia (bottom left) to Tarraco.

Inv. CE37o86, photo Museo Nacional de Arte Romano, Mérida, and Jonathan Edmondson.



FIGURE 2.59 Mérida: Tarraco (bottom left) to Pannonia Inferior.

Inv. CE37o86, photo Museo Nacional de Arte Romano, Mérida, and Jonathan Edmondson.



FIGURE 2.60 Mérida: Pannonia Inferior and (above) Pannonia Superior.

Inv. CE37o86, photo Museo Nacional de Arte Romano, Mérida, and Jonathan Edmondson.



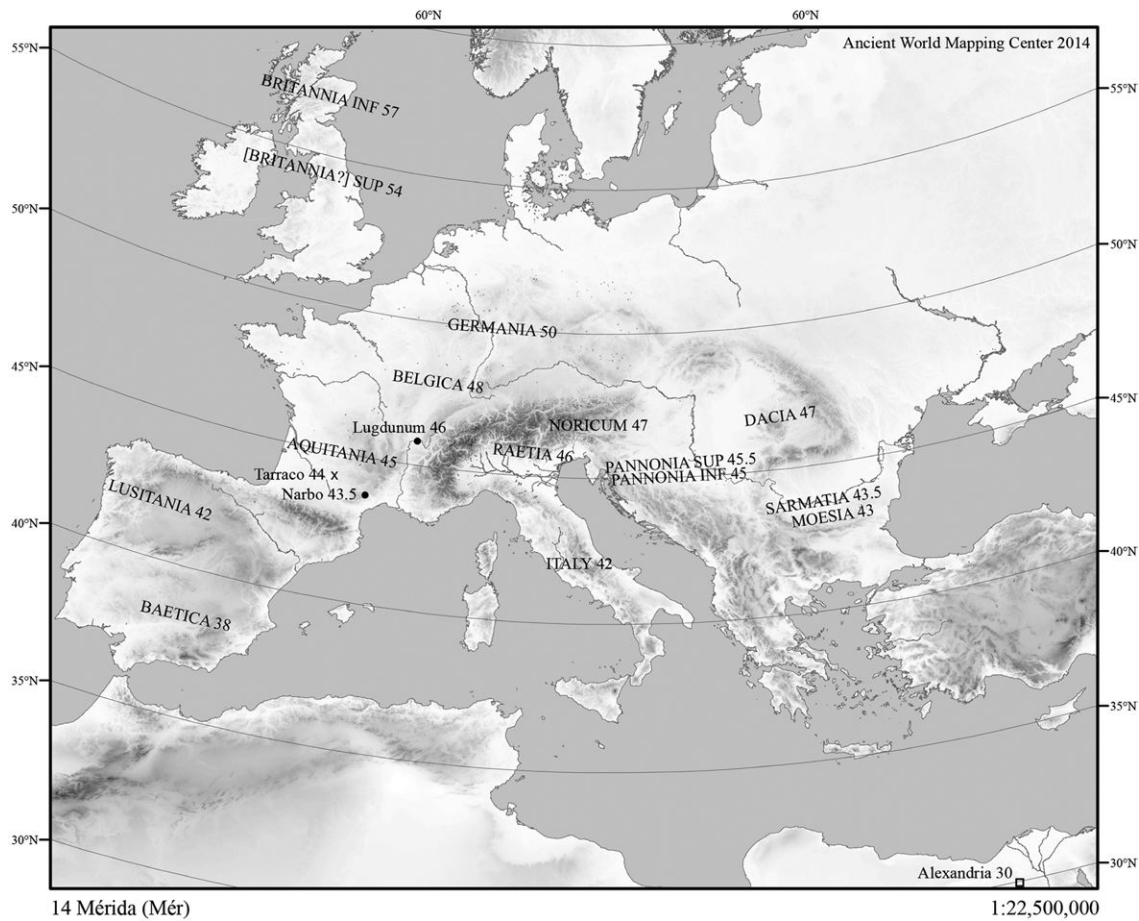
FIGURE 2.61 Mérida: Raetia (bottom left) to Dacia.

Inv. CE37086, photo Museo Nacional de Arte Romano, Mérida, and Jonathan Edmondson.



FIGURE 2.62 Mérida: Belgica (bottom left) to Britannia Inferior.

Inv. CE37086, photo Museo Nacional de Arte Romano, Mérida, and Jonathan Edmondson.



MAP 2.12 Mérida, no. 14.

Ancient World Mapping Center.

figure is separated by a pair of (incomplete) circles; compare the Rome sundial (no. 1). Figure 2.56 presents a drawing of the reverse. To photograph it satisfactorily is a challenge: Figure 2.55 presents an overview, and Figures 2.57 through 2.62 focus on successive names and their latitude figures at close range.

Dating The evident reference to two British provinces (Superior, Inferior)—a division made during the decade or so after the death of Septimius Severus in 211 (CAH² vol. 12, 8)—indicates that this sundial cannot predate the early third century. If its list of names was still being inscribed after around 300, however, then it would no longer be up-to-date in its reference to provincial organization, because from that time there were four British provinces, none with Inferior or Superior in its name (CAH² vol. 12, 707).

Bibliography

Javier Arce, “Viatoria pensilia: Un nuevo reloj portátil del s. III d. C. procedente de *Augusta Emerita* (Mérida, España),” in Börje Magnusson et al. (eds.), *Ultra Terminum Vagari: Scritti in Onore di Carl Nylander* (1997), 3–7; reprinted in Javier Arce, *Mérida Tardorromana* (300–580 d. C.) (2002), 215–26.

Jérôme Bonnin, “Les horologia Romana en Hispanie, mobilier, histoire et réalités archéologiques,” *Archivo Español de Arqueología* 83 (2010): 183–98 at 193.

Savoie and Goutaudier (2012).

Winter (2013), 313–14 (*Augusta Emerita* no. 2).

15 British Museum, London (Bri)

British Museum, London, MCC6897 [<http://collection.britishmuseum.org/id/object/MCC6897>]

Material Low-zinc brass, with minor amounts of lead and traces of other elements including tin

Dimensions (disc) Diameter 11 cm, depth 3 mm

Provenance and ownership No record of provenance. Owned by two private collectors in succession until acquired by the British Museum in 1997, as Silke Ackermann states in her publication (2003, 16 n. 2).

Description Two components survive, a suspension arm and ring, and a disc (Figs. 2.63 and 2.64). The **arm** (total length 7.8 cm) at its lower end forms a circle matching in diameter (8 mm) the central hole of the disc. The upper end of the arm is continued to fit over the circumference of the disc, and ends in a triangular pointer that can be moved along the rim of the obverse where latitudes are marked. Attached at the upper end of the arm is a **ring** (diameter 2.7 cm) for suspending the sundial. Close to the **obverse** rim of the disc (but not at the very edge), latitude figures up to 90 are marked off and inscribed in Greek figures from 3 onward at 6-degree intervals clockwise (3, 9, 15, 21, etc.), with one (3-degree) subdivision of each interval also marked (but not numbered). Above, closest to the rim (and not mentioned by Ackermann 2003, 17), a further sequence of Greek figures is

inscribed—without divisions between them—starting with 6 and continuing in multiples of 6 (6, 12, 18, 24, etc.). The two series of figures are consciously placed in relation to one another; so, for example, 36 above is to be found, appropriately, midway between 33 and 39 below. The upper series of figures would seem to be no more than another convenient aid to the user. At either end of a diameter line a fan-shaped network of lines is inscribed, with the names of the months in the Julian calendar abbreviated in Greek (six on each scale). The abbreviations at the end nearer the latitude figures are listed first:



FIGURE 2.63 British Museum, no. 15: obverse with the upper end of the suspension arm and the ring.

Photo: The Trustees of the British Museum.

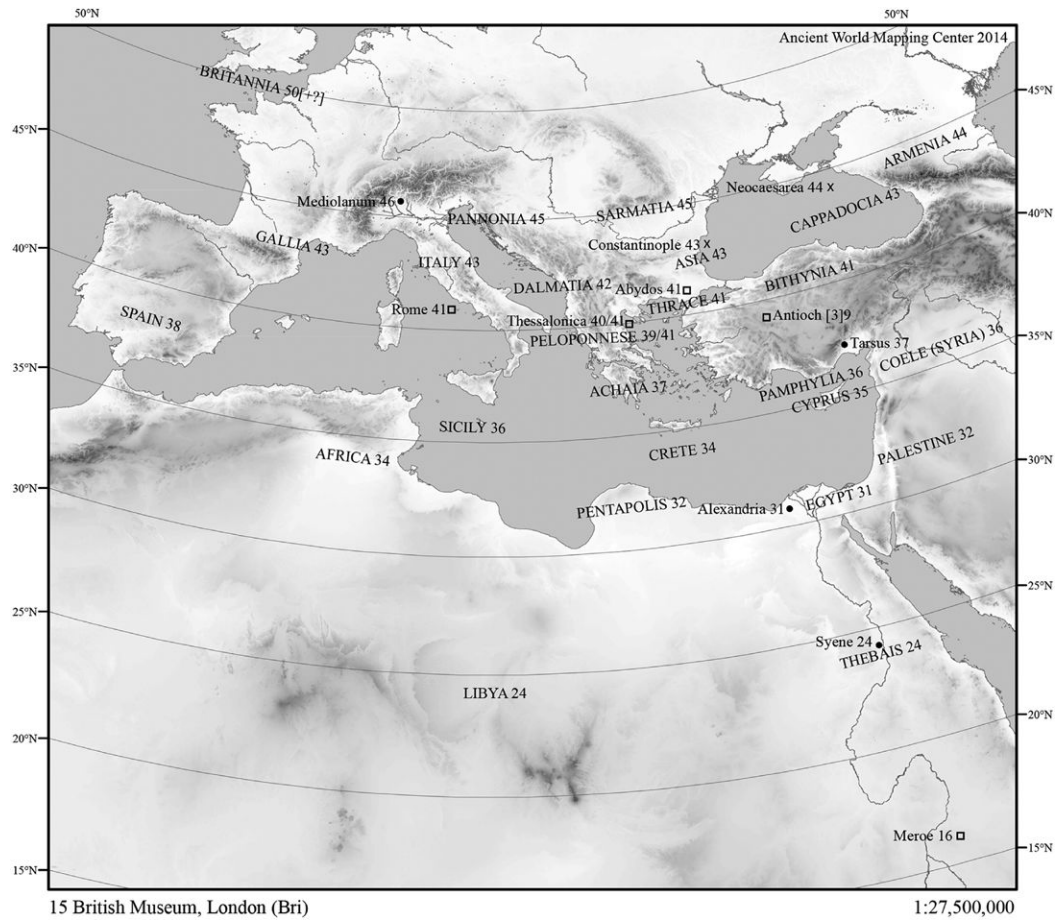
ΙΑ	ΦΕ	ΜΑΡ	ΑΠΡ	ΜΑΙ	ΙΟ
ΙΟ	ΑΥΓ	ΣΕΠ	ΟΚΤ	ΝΟ	ΔΕ

On the **reverse**, thirty-six names are inscribed in Greek, each with a corresponding latitude figure (Map 2.13). Because of corrosion and wear on this side of the disc, however, it has been possible to recover many of the names only with the use of RTI (Bevan, Lehoux, and Talbert 2013). In the listing, there is

an underdot below any letter that still cannot be read with confidence. The names run outward from just beyond two circles drawn close to one another not far from the center of the disc; a further circle separates each name from its figure inscribed close to the rim. A line separates each name and figure from the next:

ΜΕΡ ^ο ΗC	ΙC	Meroe	16	16 25	17 00
COHNHC	KΔ	Syene	24	23 50	24 00
ΘΗΒΑΤΔ	KΔ	Thebais	24	23 50–28 00	~24–28
ΛΙΒΥHC	KΔ	Libya (<i>south?</i>)	24	<i>south</i> –25 00	~south–25
ΑΙΓΠΤΟΥ	ΛΑ	Egypt	31	23 50–31 20	~24–31
ΑΛΕΞΑΝΔ	ΛΑ	Alexandria	31	31 00	31 10
ΠΑΛΑΙCΤ	ΛΒ	Palestine	32	30 40–32 30	~31–33
ΠΕΝΤΑΠ	ΛΒ	Pentap-olis/-eis	32	31 00–31 40	~32–33
ΑΦΡΙΚΗ	ΛΔ	Africa	34	25 00–33 20	~south–37
ΚΡΗΤΗC	ΛΔ	Crete	34	34 00–35 30	~35–36
ΚΥΠΡΟΥ	ΛΕ	Cyprus	35	34 40–36 10	34 40–35 40
ΚΟΥΛΗC	ΛC	Coele (Syria)	36	34 30–38 00	~35–37
CΙΚΞΛ[.]Α	ΛC	Sicily	36	36 00–38 30	36 40–38 20
ΠΑΜΦΥΛ	ΛC	Pamphylia	36	36 30–38 30	~37–38
ΑΧΑΞΙΑC	ΛΖ	Achaia	37	34 20–38 30	~36–40
ΤΑΡCΟΥC	ΛΖ	Tarsus	37	36 50	36 50
CΠΑΝΙΑC	ΛΗ	Spain	38	36 00–46 00	~36–44
ΑΝΤΙΟΧΟ	[.]Θ	Antioch (<i>Pisidia?</i>)	[3]9	39 15 (38 50)	38 20
ΠΕΛ[.]ΠΟ	[..]	Peloponnese	39 or 40 or 41?	34 20–37 00	36 20–38 20
ΘΕCΣΑΛΟ	Μ[.?	Thessalonica	40 or 41?	40 20	40 40
ΡΩΜΗC	ΜΑ	Rome	41	41 40	41 50
ΘΡΑΚΗC	ΜΑ	Thrace	41	40 40–44 40	~40–43
ΒΙΘΥΝΙΑ	ΜΑ	Bithynia	41	41 15–43 30	~40–42
ΑΒΥΔΟC	ΜΑ	Abydos	41	41 15	40 10
ΔΑΛΜΑΤ	ΜΒ	Dalmatia	42	41 00–45 00	~42–45
ΚΑΠΠΑΔ	ΜΓ	Cappadocia	43	37 30–43 00	~38–41
ΙΤΑΛΙΑC	ΜΓ	Italy	43	38 00–45 00	~38–46
ΚΩΝCΤΑ	ΜΓ	Constantinople	43	43 05	41 00
ΓΑΛΛΙΑC	ΜΓ	Gallia	43	42 10–53 30	~43–51
ΑCΙΑ	ΜΓ	Asia	43	35 30–41 30	~36–40
Ν[.]ΟΚΑΙCΟ	ΜΔ	Neocaesarea (<i>Pontus?</i>) (<i>see comment below</i>)	44	41 50	40 30
ΑΡΜΕΝ[.]Α	ΜΔ	Armenia	44	38 00–44 30	~38–41
CΑ[.]Μ[...]Α	ΜΕ	Sarmatia	45	48 30– <i>north</i>	~47– <i>north</i>
ΠΑΝΝΟΝΙ	ΜΕ	Pannonia	45	44 30–48 00	~45–48
ΜΕΔΙΟΛΑΝ	ΜC	Mediolanum	46	44 15	45 30
ΒΡΕΤΤΑΝ	Ν[.?	Britannia	50[+?]	51 30–59 00	~50–59

For discussion of which cities named Antioch and Neocaesarea may be meant, see Chapter 3 section 4.



MAP 2.13 British Museum, no. 15.

Ancient World Mapping Center.



FIGURE 2.64 British Museum: reverse with the suspension arm and the ring.

Photo: The Trustees of the British Museum.

Note the strong correspondence between the names and their latitude figures on this sundial and those on the Time Museum sundial no. 10; see further Chapter 4 section 1.

Dating No earlier than the foundation of Constantinople in the 320s.

Bibliography

Silke Ackermann, "Light on Byzantium—A Universal Sundial in the British Museum," in Chris Entwistle (ed.), *Through a Glass Brightly: Studies in Byzantine and Medieval Art and Archaeology Presented to David Buckton* (2003), 16–21.

Winter (2013), 613–15 (Fundort unbekannt no. 15).

George Bevan, Daryn Lehoux, and Richard Talbert, "Reflectance Transformation Imaging of a 'Byzantine' Portable Sundial," *ZPE* 187 (2013): 221–29.

16 Balkans (Bal)

Privately owned

Material Brass, composed of 75 percent copper, 21 percent zinc, and traces of other elements including tin (Hoët-van Cauwenberghe 2012a, 558, Table 1)

Dimensions Diameter 11.5 cm

Provenance and ownership There is no record of provenance, although the suspicion that the sundial was found in Bulgaria with the use of a metal detector seems plausible. In 2008 the sundial was acquired in Germany by a private individual, but was also shown to the Römisch-Germanisches Zentralmuseum, Mainz, where a full record was made and two copies were even produced (inv. no. 42764).

Description Only a thin disc survives, and it has suffered some damage from warping and gashes. In addition to the usual small hole at the center, the **obverse** has a slightly raised rim (Figs. 2.66 and 2.67). Two diameter lines divide it into four quadrants. Near either end of one of these lines (approximately 5 mm from the rim), a fan-shaped network of lines is inscribed, with the names of the months in the Julian calendar abbreviated in Greek (six on each scale); these are placed along the upper of two arcs and separated by vertical dividers. The dividers continue to the lower of the two arcs, but the further spaces thus created remain empty. The group of month names July–December is to be read from right to left (but no letters are reversed):

ΙΑ	ΦΕ	ΜΑΡ	ΑΠΡ	ΜΑΙ	ΙΟ
ΔΕΚ	ΝΟΕ	ΟΚΤ	ΣΕΠ	ΑΥΓ	ΙΟΥ

A broken circle visible close to the central hole seems best explained as the consequence of abrasion to which the surface was subject when the (lost) shadow caster and hour scale—secured by a bolt through the hole—was rotated on this side of the sundial.

Division of the **reverse** into four quadrants by two lines matches the division of the **obverse** (Figs. 2.65 and 2.68). Similarly, traces of four more or less broken circles close to the central hole seem best explained as the consequence of the abrasion already noted on the **obverse**. Names of twelve cities or regions in total (three in each quadrant) run inward from a circle drawn approximately 6 mm in from the rim (Map 2.14). Each name is separated from the next by an underline. The size of the lettering varies a little between names, as does the spacing from one name to another. There are no latitude figures. Instead, exceptionally, each name's underline furnishes its latitude

setting. No doubt the names have been chosen in part because in each group the location of one city or region is reckoned to be approximately 5° from the next (perhaps around double that interval in the case of Libya to Syria; the former name is likely to signify Africa south of the provinces of Mauretania and Africa):

ΑΛΕΞΑΝΔΡΕΙΑ	Alexandria
ΑΘΗΝΑΙ	Athens
ΡΩΜΗ	Rome
(break)	
ΡΟΔΟΣ	Rhodes
ΣΙΚΕΛΙΑ	Sicily
ΘΡΑΚΗ	Thrace
(break)	
ΛΙΒΥΗ	Libya (south?)
ΣΥΡΙΑ	Syria
ΜΥΣΙΑΝΩ	Moesia Superior
(break)	
ΒΑΒΥΛΩΝ	Babylon
ΑΣΙΑ	Asia
ΜΥΣΙΑΚΑ	Moesia Inferior

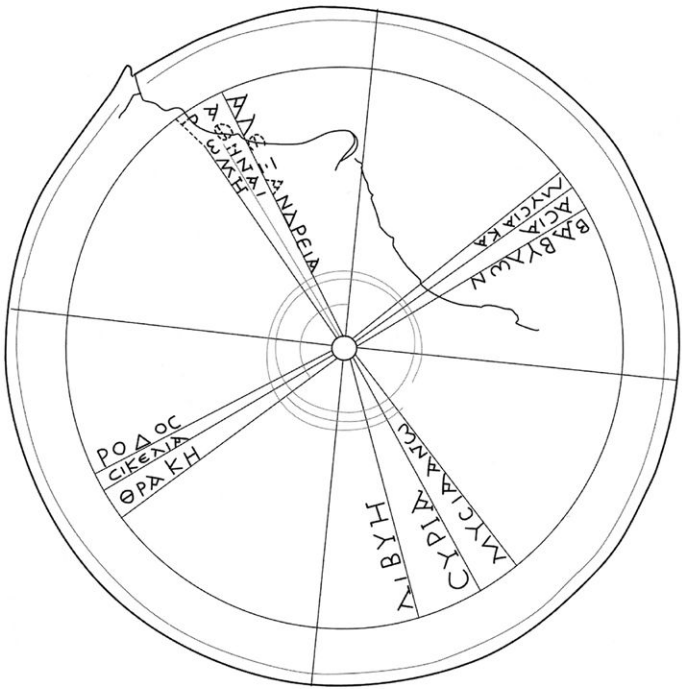


FIGURE 2.65 Balkans: reverse drawing.
Ancient World Mapping Center.



FIGURE 2.66 Balkans, no. 16: obverse.

Photo: Römisch-Germanisches Zentralmuseum, Mainz, Germany, and R. Müller.

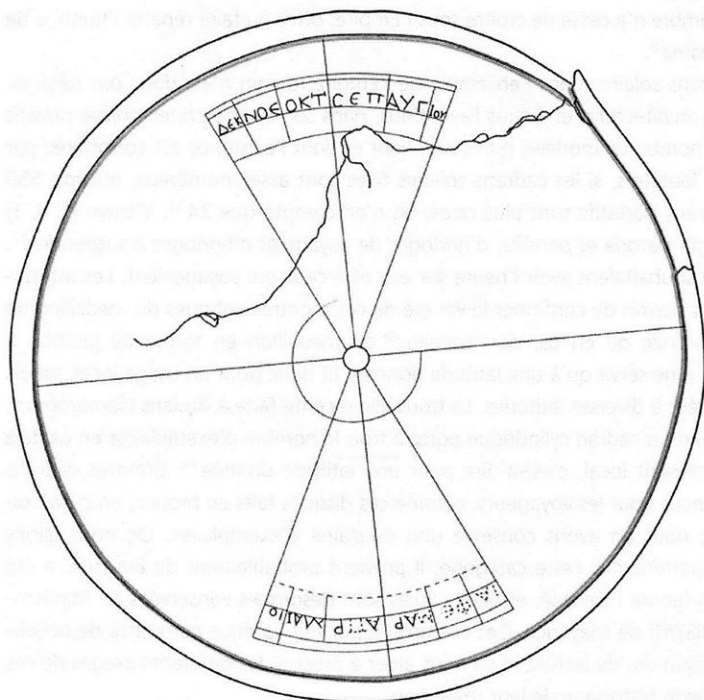


FIGURE 2.67 Balkans: obverse drawing.

Christine Hoët-van Cauwenberghe in *Archäologisches Korrespondenzblatt* 42 (2012): 556, fig. 1b.



FIGURE 2.68 Balkans: reverse.

Photo: Römisch-Germanisches Zentralmuseum, Mainz, and R. Müller.

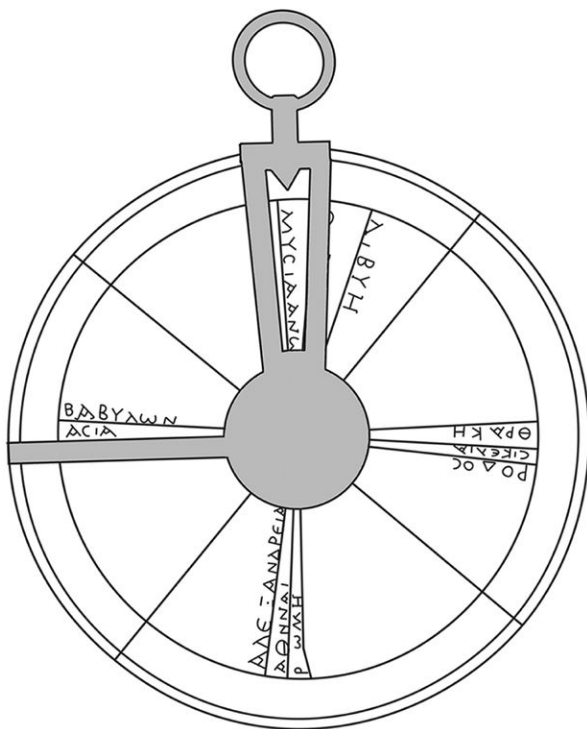
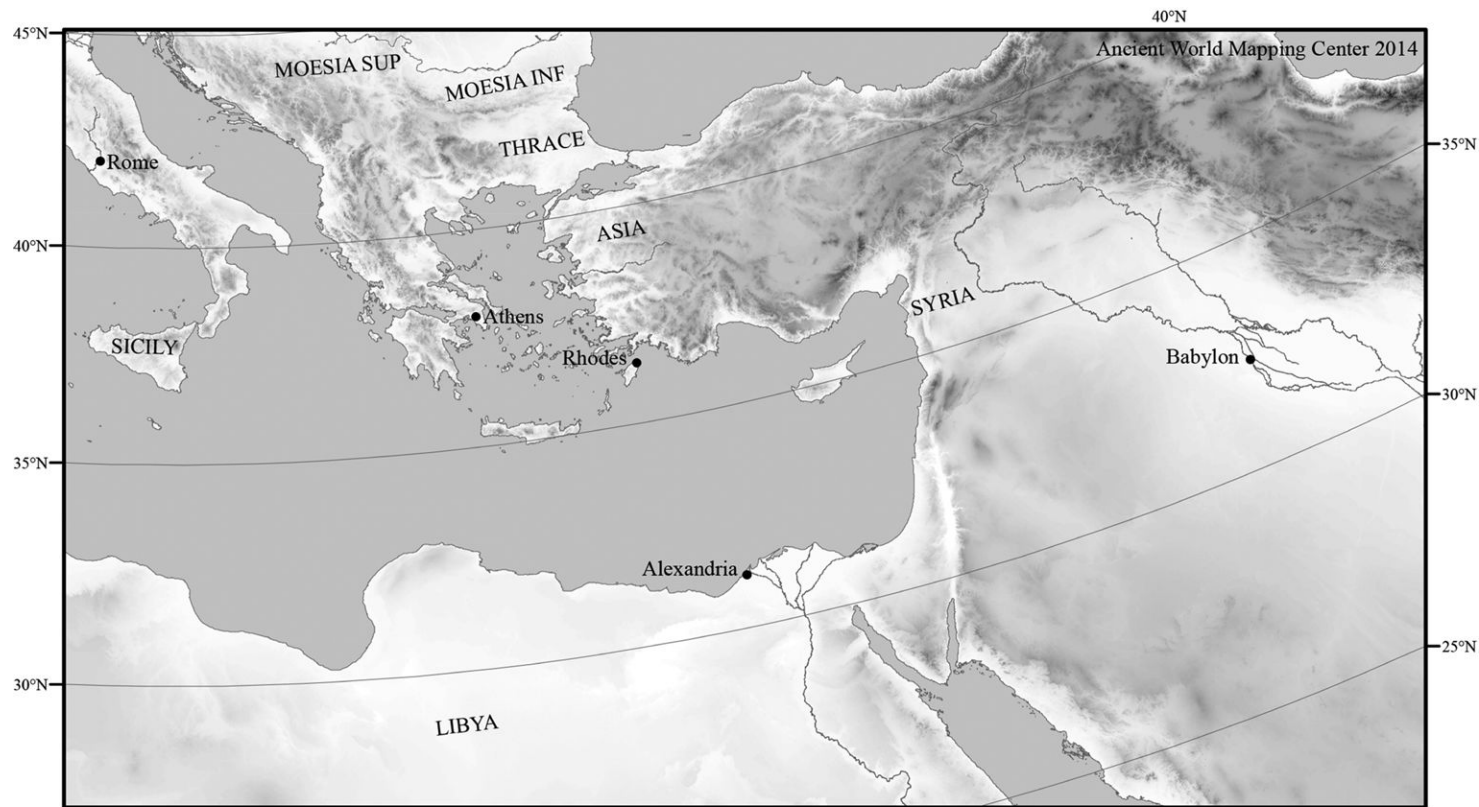


FIGURE 2.69 Balkans: reconstruction of reverse and arm drawing.

Ancient World Mapping Center.



16 Balkans (Bal) with all names at their correct latitudes

1:20,000,000

MAP 2.14 Balkans, no. 16.

Ancient World Mapping Center.

For the Alexandria and Libya groups of names, the (lost) suspension arm must be rotated so that the underline for the name is exactly vertical; for the Rhodes and Babylon groups of names, the arm must be rotated so that the underline is exactly horizontal, as reconstructed in Figure 2.69. It was therefore essential for the arm to be designed not only to extend vertically in the regular way, but also—as in the reconstruction sketch here—to include a bar at 90° from the vertical that can be placed horizontally across the disc. Christine Hoët-van Cauwenberghe (2012a, 562) errs in not recognizing the need for such an additional component to the arm. Moreover, her figure 2c shows a vertical setting for Asia, not a horizontal one, a slip that would give a false reading.

Dating Hoët-van Cauwenberghe argues that the style of the lettering points to a second- or third-century date (2012a, 560). Inclusion of Moesia Inferior and Moesia Superior among the names demonstrates that the sundial can only have been made after Domitian divided Moesia into two provinces in 86 (*BNP* ss. vv. Moesi, Moesia). From the fact that Rome is included, but not Constantinople, Hoët-van Cauwenberghe (2012a, 565) considers it very probable that the sundial predates the foundation of the latter in the 320s; there can be no certainty on this point, however.

Bibliography

Christine Hoët-van Cauwenberghe, “Cadrans solaires portatifs antiques: un exemplaire inédit provenant des Balkans,” *Archäologisches Korrespondenzblatt* 42 (2012a): 555–71. Too recently published for Winter (2013).

See the Gazetteer at the back of the book for all the locations named on the sundials described in this chapter. A Table of Latitudes and Locations and three overview maps (G.1, G.2, G.3) accompany the Gazetteer.

3

Geographical Awareness and Worldviews

Ptolemy's comprehensive *Geography* provides latitude and longitude coordinates for an astonishing 6,345 locations in total.¹ By comparison, the various place names in Greek or Latin selected for inclusion on the sixteen geographical portable sundials described above in Chapter 2 amount to approximately 115 (marked on Map G.3, p.207 below). Most are accompanied by a single figure for latitude; no figure for longitude is ever included. This number of place names, although not trivial and sure to grow as further discoveries are made, manifestly pales beside the wealth of them to be found in the *Geography*. Even so, the fact is that no such pairings of place name and latitude figure in this form survive in any other sources, Greek or Latin, textual or inscribed. Accordingly, the 115 on the geographical portable sundials—while the outcome of conscious choice on the one hand, yet chance survivals on the other—have unique potential significance as indicators of an educated public's geographical awareness and worldviews. This chapter aims to explore those hitherto neglected indicators, while the following chapter proceeds to consider who might have produced or commissioned or used portable sundials of this type, and with what purposes in mind.

1. Names

If we confine our attention initially to the names, the uniformity of their format in both languages is at once striking. This is not to say that the form of a name chosen for inclusion on more than one sundial is invariably identical, or that there is an absence of shortened forms let alone

1. For this number, see Stückelberger, et al. (eds.), *Klaudios Ptolemaios Handbuch der Geographie: Ergänzungsband* (2009), 241. On Stückelberger's count, the *Geography* includes a further 1,404 names without these coordinates, all of them physical features or peoples.

of spelling mistakes, which are commonly made by Greek and Roman writers and engravers. However, perusal of the Gazetteer at the back of this book can quickly confirm that most variants are minimal (as in the spelling of Carthage, for example), and that a shortened form of a name liable to perplex an individual with sufficient education to use such sundials is rare. We may reckon that typically, in any case, such a list of names was inscribed just for the private use of the individual who had commissioned it in the first place, not for a wider circle, much less the public.² GAL on the Oxford sundial (Galatia? Gallia?) might conceivably cause hesitation. However, given that its latitude figure is 48, and that originally the only other names on this sundial were NARB, BRIT, GER, LVGD and ITAL, there could have been little doubt then that Gallia was meant. GERI and GERS on the same sundial, as well as PANN I and PANN S on the Mérida sundial, are likewise very short names, but again an educated user would hardly need more than an instant to grasp what each signifies, especially as one is placed after the other on both sundials. Uncertainty over what QVIRINE and INSVRIA each signify—also on the Oxford sundial, as well as placed one after the other—may stem from slips or spelling mistakes at some stage in the selection and inscription of these names. Even so, in general the forms of names would be readily comprehensible. APHRICE for Africa on the Latin Rome sundial, a unique occurrence and presumably a direct transcription of Greek, would pose no puzzle. Spelling mistakes like ILATIA for ITALIA on the Mérida sundial or ΘΗΒΑΤΑ for ΘΗΒΑΙΑ on the British Museum sundial are insignificant, as are the omissions of a vowel or consonant from AFRCA and PANONI on the Oxford sundial, ΑΙΓΠΤΟΥ on the British Museum sundial, and the first N of Constantinople (thus ΚΩCΤΑ) on the Samos and Science Museum sundials.

Equally untroubling to users no doubt would be the inconsistency of the case in which names are listed.³ The choice is always nominative or genitive evidently, although from where the compiler of a list might be likely to take over names in the genitive is uncertain. Ptolemy's *Geography* typically lists cities and regions in their nominative form. One source of genitive forms may conceivably be lists presented as “the co-ordinates of X are . . .,” the style evident on the Philippi sundial. In general, both because shortage of space acts to leave long names unfinished and because there is some preference for inscribing just the initial letters of names, it is often impossible to tell which case a compiler intended for a name. In all likelihood many compilers attached no importance to

2. For the potential difficulties of interpreting the abbreviated geographical names inscribed in large numbers on an unusual and remote public monument, see Brian Turner, “War Losses and Worldview: Re-viewing the Roman Funerary Altar at Adamclisi,” *AJP* 134.2 (2013): 277–304 at 293–96.

3. Similar inconsistency is found in the itineraries and on the Peutinger Map (cf. Talbert 2010a, 107 note 141, and 109); the oblique cases most often found there are the ablative and accusative. On the Map some names of peoples occur in the genitive plural (such as NVMDARVM), with a collective noun like *natio* to be understood.

consistency of presentation in this respect and scarcely gave it attention. That said, it would seem as if the compiler of the Time Museum list had the genitive firmly in mind for all its names, although the nominative ANTIOXIA still occurs here despite the availability of space in which to fit the genitive ANTIOXIAC. The same not fully consistent preference for the genitive is to be seen on the British Museum sundial (but note ACIA) and the Rome sundial (but note ARABIA). There is an apparent mix of the two cases in the Vignacourt and Oxford lists, although in the former all the names could be completed as genitives, and in the latter the many very short forms used give no clue to the endings envisaged. Similar shortening is a feature of the lists on the Samos and Mérida sundials too.⁴ Most consistent in their adherence to one case are the Crêt-Châtelard list (genitive), and the Memphis and Balkans lists (both nominative, the former one of the longest lists). Uniquely and curiously inconsistent is the practice of the Aphrodisias list, which alternates between the two cases with such frequency—most cities in the nominative, most other names in the genitive—that some deliberate purpose or two sources of information could even be suspected; any purpose for alternating the cases is hard to envisage, however.

Whether it be accident or design, on all the sundials the names chosen for listing seem to be regions or cities only. Physical features—even the most prominent mountain ranges, capes, rivers, lakes, or open water, such as what Ptolemy's *Geography* includes—are ignored for the purpose that the lists are intended to fulfill. Peoples are ignored too.⁵ It is true that SARMAT in the Mérida list (where, as just noted, the forms used for many names omit their endings) could be taken as the people SARMATAE, but the style of this list and comparison with SARMATIA as spelled out on the Vignacourt and British Museum sundials both argue against this interpretation. Abydos on the British Museum sundial would no doubt bring the Hellespont to users' minds, and was perhaps intended to; even so, the city is chosen for listing rather than the well-known, strategic strait.⁶ Altogether in the case of three names (at their longest LVGDVN, NARBON, TARRAC), the absence of an ending leaves it unclear whether the Roman province is meant (Lugdunensis, Narbonensis, Tarraconensis), or the city from which the province is named (Lugdunum, Narbo, Tarraco). Some compilers may even have preferred to blur this distinction, and thus regarded the option of not completing these names as a convenience. Uniquely—and outside the Roman empire—Babylon (Balkans and Rome sundials) and Babylonia (Crêt-Châtelard sundial) are distinguished. By contrast, the city and island of Rhodes (listed on

4. In the Mérida list, if NARBON is taken to be Narbonensis, then all the names can be read or completed as nominatives.

5. Ptolemy lists few peoples in his *Geography*, and without coordinates; he locates them mainly with reference to major physical features.

6. Compare the choice of Hellespont for a plate of the Greek astrolabe dated 1062: see Chapter 5 section 1 and Figure 5.1B.

six sundials) are not, a lack of distinction that need make no difference to users. It is equally irrelevant to them whether or not any compiler had it in mind to distinguish between islands and Roman provinces when listing Crete, Cyprus, Sardinia, and Sicily.

Names that can readily be taken as signifying Roman provinces constitute the great majority among the regions chosen for listing. Indeed, the name of almost every province into which the empire was divided by the early third century CE (Map 3.1) can be found in the lists, even including all the subdivisions into “Upper” (*Superior*) and “Lower” (*Inferior*)⁷—or in the case of Syria, into Coele and Phoenice—except for the division of Mauretania into Tingitana and Caesariensis.⁸ The provinces not to be found at all are few. The only longstanding ones are the three small Alpine districts to the northwest of Italy; otherwise there are four more recent creations missing—Epirus, Mesopotamia, Numidia, and Osroene. It is true that Pontus and Corsica are also missing, but their absence is unremarkable insofar as each in fact furnished the second name of combined provinces with Bithynia and Sardinia respectively.⁹

Some names might be taken to signify a region without any specific link to Roman provincial administration, or equally to point to use of the name by Roman administrators at some time or other rather than in effect permanently. Phrygia, for example, although a historically well-known region, was not detached (with Caria) from Asia to form a separate Roman province until the mid-third century. Similarly Libya, another historically well-known region, became a province of that name (or two in fact, Superior and Inferior) only around the end of the third century CE, when the Tetrarchs reorganized the administration of territory previously spanned by Cyrene and western Egypt. Callectia in north-west Spain,¹⁰ Thebais in Egypt, and Campania and Tuscia in Italy are comparable instances, recognized regions without separate Roman provincial status or the equivalent until the reforms instituted by the Tetrarchy. Illyricum, by contrast, was no longer the name of a province after the first century CE, but the name continued in use as that of a large customs district (*portorium Illyricum*) of Danubian provinces; it was also used for two “dioceses” (groupings of provinces for administrative supervision) created in the early fourth century.¹¹ Four

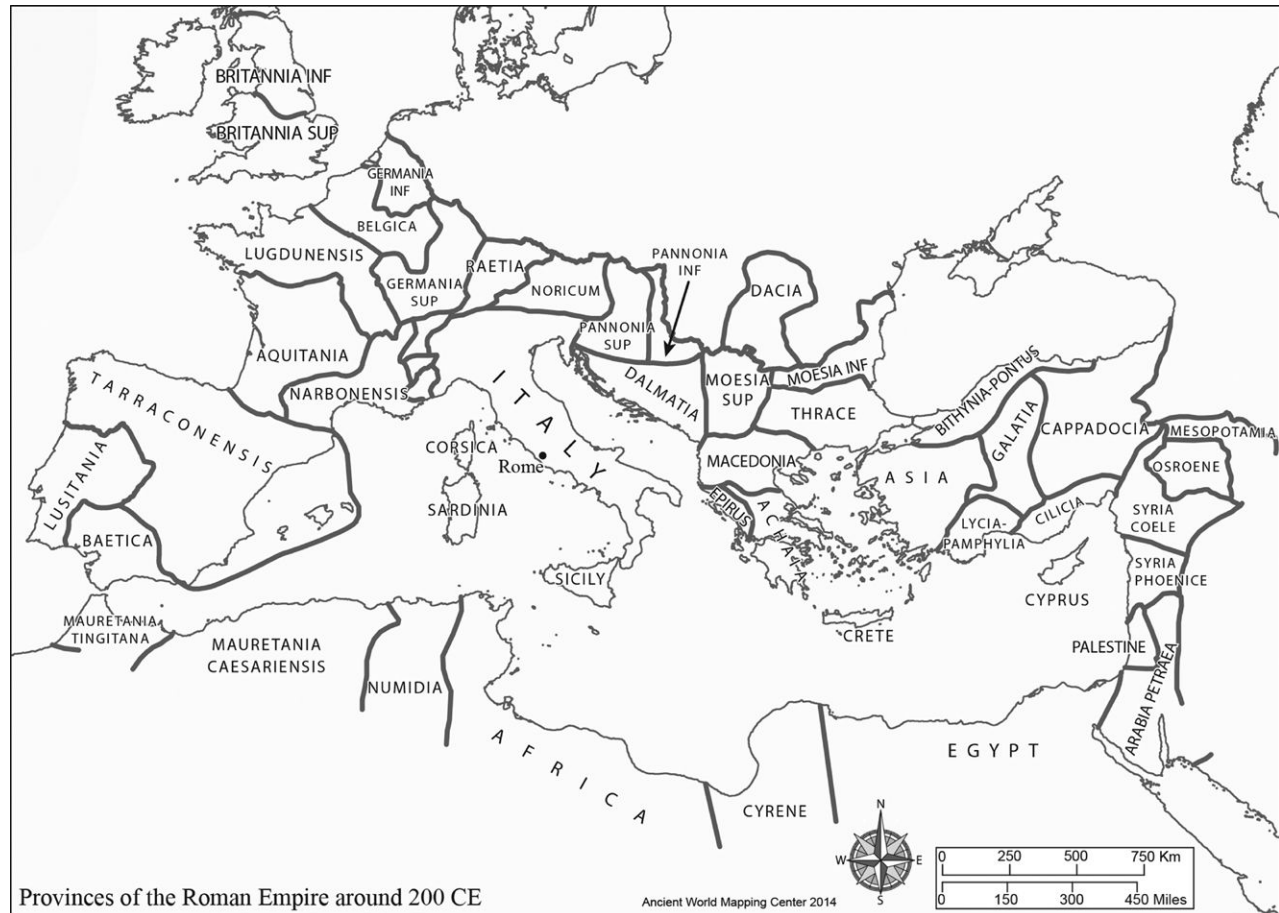
7. I agree with Benet Salway (in Talbert 2012a, 217–19) that the unstated point of reference for this distinction is the city of Rome; a *Superior* subdivision is thought to be geographically closer to Rome, an *Inferior* more distant.

8. On changes in Roman provincial organization during the third and early fourth centuries, see CAH² vol. 12, 705–13 (by John Wilkes); *BAAtlas* Maps 100 and 101, with *Directory* for each.

9. The compiler of the British Museum list, with a manifest interest in Asia Minor, included Bithynia, but conceivably opted for the city of Neocaesarea instead of Pontus; see further Chapter 4 section 2.

10. See *Tabula Imperii Romani* K-29, *Porto/Conimbriga* (1991), s.v. Callaecia.

11. See in brief OCD⁴, s.v. Illyricum (by John Wilkes).



MAP 3.1 Provinces of the Roman Empire around 200 CE.

Ancient World Mapping Center.

other regional names well known within the Roman empire appear in the lists, even though they did not signify provinces officially: Hellas, Judaea, Peloponnese, and Pentapolis.¹² Armenia, Babylonia, Ethiopia, India, and Sarmatia would no doubt all be recognized as regions within Rome's world, but hardly as integral parts of the empire; Arabia and Germania could be taken as either.

Especially because the lists on as many as six sundials include the city of Constantinople—established with that name only early in the fourth century—the apparent absence of distinctive names and divisions (such as *Prima*, *Secunda*) that clearly reflect the drastic provincial re-organization carried through by the Tetrarchs and subsequently by Constantine is matter for comment. It is true that many of the existing names for provinces continued in use (now signifying dioceses in the cases of Africa and Thracia). Moreover, as just noted, Callectia, Campania, Libya, Thebais, and Tuscia could all signify newly created provinces, but they equally well might not. Similarly, although the plural Galliae in four lists (Aphrodisias, Crêt-Châtelard, Memphis, Rome) might signify the Tetrarchic diocese Galliae, straightforward recognition that the large region of Gaul encompassed several provinces (as it had done for centuries) seems the more plausible interpretation. It remains possible that the absence of distinctive names in use after the Tetrarchic reorganization is the outcome of mere chance or laziness, but some level of conscious avoidance should not be ruled out.¹³

2. Figures: The Concept of Latitude

We should now turn to the latitude figures that accompany each name listed on twelve of the sundials (in the other four cases, latitude is provided by alternative means).¹⁴ As all sixteen demonstrate, however, for the design and functioning of sundials the concept of latitude is fundamental. The Roman encyclopedist Pliny the Elder, writing in Latin in the late first century CE,¹⁵ explains the reason:

Vasaque horoscopa non ubique eadem sunt usui, in trecenis stadiis
aut, ut longissime, in quingenis mutantibus semet umbris solis;
itaque umbilici, quem gnomonem appellant, umbra in Aegypto
meridiano tempore aequinoctii die paulo plus quam dimidiam

12. The Greek name Pentapolis was used from the late first century CE for the five cities of central Cyrenaica in North Africa; hence the plural version Pentapoleis. See in brief *OCD*⁴, s.v. Pentapolis (by Joyce Reynolds).

13. See further below Chapter 4 section 6.

14. See the descriptions of nos. 2 (Kircher), 4 (Aquileia), 5 (Vienna), and 16 (Balkans) in Chapter 2.

15. For a concise, informative account of each ancient writer cited in this section, see the relevant entries in Keyser and Irby-Massie (2008).

gnomonis mensuram efficit, in urbe Roma nona pars gnomonis deest umbrae, in oppido Ancona superest quinta tricesima, in parte Italiae, quae Venetia appellatur, isdem horis umbra gnomoni par fit. Simili modo tradunt in Syene oppido, quod est supra Alexandriam quinque milibus stadium, solstitii die medio nullam umbram iaci...¹⁶

And instruments for telling the time cannot be used universally, because the sun's shadows shift every 300 stades,¹⁷ or at the furthest every 500. So in Egypt, at noon on the day of the equinox, the shadow of the shadow caster (what is called the *gnomon*) measures a little more than half the *gnomon*; in the city of Rome the shadow is one-ninth shorter than the *gnomon*; in the town of Ancona it is one thirty-fifth longer; at the same hour in the region of Italy called Venetia¹⁸ the shadow and the *gnomon* are the same length. Likewise, reports state that in the town of Syene, situated 5,000 stades beyond Alexandria, no shadow is cast at noon on the day of the solstice.

The concept of “latitudes” or parallel lines imagined as encircling the globe, each situated at its own distinct angle in relation to the sun, is a Greek one, closely associated in the first instance with the attempt of the scientist Eratosthenes (c. 285–205 BCE) at Alexandria to calculate the earth's circumference.¹⁹ The (imaginary) line where day and night are of equal duration is a natural starting point for recording and comparing latitudes. To the north and south of this “equator” line, the position of any spot on the globe can most readily be calculated either by measuring the length of the shadow cast by a *gnomon* at an equinox (March 20–21 and September 22–23, the two days in the year when day and night have equal length), or by observing the length of the day at the summer solstice (June 20–21, the longest day of the year). Hence the Roman architect and engineer Vitruvius, writing in Latin during the late first century BCE, reflects:

Ea autem sunt divina mente comparata habentque admirationem magnam considerantibus, quod umbra gnomonis aequinoctialis alia magnitudine est Athenis alia Alexandriae alia Romae non eadem

16. *Natural History* 2.182–83, ed. Jean Beaujeu (1950).

17. Probably a distance of about 35 British or American miles (56 km) is meant.

18. *BAAtlas* 19 D4, 40 A1.

19. There is no recent scholarly study focused on latitudes. Without doubt, to trace the unfolding of the concept is an exercise in frustration when we have so little of the relevant works by Eratosthenes, Hipparchus, and Marinus, and when the ancient reports about them that do survive are typically hostile. Daniela Dueck, *Geography in Classical Antiquity* (2012), 92–96, offers a useful overview. See a fuller discussion of some stages by D. W. Roller, *Eratosthenes' Geography* (2010); and Berggren and Jones (2000), esp. 17–30.

Placentiae ceterisque orbis terrarum locis. Itaque longe aliter distant descriptiones horologiorum locorum mutationibus.²⁰

These [phenomena] have been created by a Divine Mind, and those who ponder them are greatly impressed that the shadow of a *gnomon* at the equinox has one length at Athens, another at Alexandria, another at Rome, and a different one at Placentia²¹ and at other places in the world. Thus the designs of sundials vary considerably from place to place.

Pliny the Elder in turn explains:

Sic fit, ut vario lucis incremento in Meroe longissimus dies XII horas aequinoctiales et octo partes unius horae colligat, Alexandriae vero XIII horas, in Italia XV, in Britannia XVII. . . .²²

In consequence, because of differences in the length of daylight, the longest day in Meroe extends to 12 and eight-ninths equinoctial hours, at Alexandria to 14 in fact, in Italy to 15, in Britain to 17. . . .²³

Although there is good reason to think that Eratosthenes devised and employed the concept of latitude, there is also every likelihood that his use of it was elaborated only subsequently by the astronomer and geographer Hipparchus (around 140–120 BCE). He developed it into a more precise system with, among other features, parallels set at fixed intervals from the equator on the basis of astronomical data,²⁴ and a longitude scheme. Hipparchus did evidently compile a table of parallels and of locations reckoned (by one means or other) to lie on them or close to them; but it would seem that these locations were few in number,²⁵ and he may well not have recorded their latitudes in the form of degrees and minutes familiar to us.²⁶

Later, the mapmaker and geographical writer Marinus (c. 100 CE) supposedly made extensive use of latitude and longitude, but the polymath scientist

20. *On Architecture* 9.1.1 Gros et al. (1997).

21. In the valley of the Padus (Po) river (*BAtlas* 39 F3).

22. *NH* 2.186 Beaujeu. On Pliny's presentation of latitude (as an afterthought), note Pierre Schneider, "Les 'climats' de Plin l'Ancien (*N.H.* 6, 212–220): essais de transcriptions graphiques," *Geographia Antiqua* 20–21 (2011–12): 179–204.

23. Equinoctial hours had to be the basis of such comparison. Seasonal ones—that is, equal twelfths of the period of daylight on any given day—always vary in length according to latitude; see Chapter 1 section 2.

24. See D. R. Dicks, *The Geographical Fragments of Hipparchus* (1960), 154–62, esp. 160.

25. Cf. Ptol. *Geog.* 1.4.2 Stükelberger.

26. Dicks (1960), 192–94.

Ptolemy (c. 150 CE) delivers a sustained and uncharacteristically scathing critique of his method as inconsistent, unreliable, and confusing.²⁷ Hence Ptolemy's avowedly much improved presentation of the latitudes and longitudes of more than six thousand settlements and features across the entire known world—organized by province or region, oriented North—made his *Geography* a highly original work.²⁸ His inspiration came from celestial mapping he had already undertaken, as well as from a related plan to establish the coordinates of “the noteworthy (ἀξίων) cities in each province,” which he mentions in his astronomical treatise *Μαθηματικὴ Σύνταξις*, commonly known as the *Almagest*.²⁹ He does indeed distinguish about 360 such cities or features as “important” in the *Geography*, and later included a “Table of Important Cities” (more or less the same places, again organized by province or region) with their coordinates in his revision of the tables in the *Almagest*, entitled the *Handy Tables* (*Πρόχειροι Κανόνες*).³⁰

3. Figures: The Concept of Latitude Applied

From the previous section it follows that Oswald Dilke evidently makes a credible claim when he states: “...there is reason to think that the latitudes of Roman provinces on the reverse of portable sundials were indebted to Ptolemy.”³¹ In other words, we may fairly infer that the extensive data offered by the *Geography*, together with the succinct form in which Ptolemy presented it, gave a quite unprecedented boost to referencing latitude and longitude sometime from the mid-second century onward. Any precise timing remains irrecoverable, but the likelihood of an early-third-century date for a papyrus fragment of a copy of the *Table of Important Cities* is notable in this connection.³² There is certainly good cause to believe that the *Geography* and its reception played a decisive role in making it practical to design and produce portable sundials that neatly incorporate

27. *Geog.* 1.6–18 Stückelberger, with discussion by Alexander Jones, “Ptolemy’s Geography: Mapmaking and the Scientific Enterprise,” 109–28 in Talbert (2012a), at 118–25. See further Chapter 4 section 4.

28. The point is stressed in the valuable treatment by Patrick Gautier Dalché, *La Géographie de Ptolémée en Occident (I^{ve}–XVI^e siècle)* (2009), 19–20.

29. See *Almagest* 2.13 (translated by G. J. Toomer, 1998), with discussion by Berggren and Jones (2000), 19.

30. The *Table of Important Cities* (*Κανὼν Πόλεων Ἐπισήμων*) is edited with German translation by Stückelberger et al. (2009), 134–215. The Greek adjective that Ptolemy uses in his sundry references to such cities varies (*ibid.*, 139).

31. See Harley and Woodward (1987), 254, and Preface above.

32. See C. H. Roberts (ed.), *Catalogue of the Greek and Latin Papyri in the John Rylands Library Manchester*, vol. III (1938), 142–46 and plate 4 (no. 522). For awareness of the *Geography* from antiquity onward, see further Stückelberger et al. (2009), 22 (stemma), 320–24; Renate Burri, *Die Geographie des Ptolemaios im Spiegel der griechischen Handschriften* (2013), 55–62.

a list of geographical names, each accompanied by a latitude figure. This is not to discount Vitruvius' awareness—almost two centuries earlier—of sundials that he describes in the passage quoted above (Chapter 1 section 3) as “for taking on a journey and hanging up” (*viatoria pensilia*). Even so, as again already noted there, sundials of this type do not need to incorporate a list of names and latitudes for their functioning, and none of those described in Chapter 2 could convincingly be dated anywhere near as early as Vitruvius' time.³³

It is credible, therefore, that Ptolemy's *Geography* did serve to create a taste for referencing latitude and longitude in its style. This said, it would be a mistake to assume further that the compilers of the lists on the geographical portable sundials were necessarily able to take their latitude figures from his work, or that even when they did consult it they opted to accept his figures, which were by no means all accurate.³⁴ A check will demonstrate that only in the exceptional instance of the Philippi sundial—with its mere four names—do all the latitudes in a list match those offered by Ptolemy in the *Geography*. In any case a city chosen for inclusion by a compiler might happen to have been omitted by Ptolemy—Adrianople (Stratonicea?) on the Memphis sundial, for instance. Moreover, provinces and regions posed a challenge insofar as Ptolemy did not offer for these the single latitude that is all our sundials (again, with remarkable consistency) ever list. Rather, at most his practice is to furnish figures for the furthest points of a province or region. From these, to be sure, it would have been straightforward to settle on a single figure. Alternatively, a latitude for any province or region could be determined from an inspection of the figures that Ptolemy offers for the principal cities and features there either in the *Geography* or in the *Table of Important Cities*.

Comparison demonstrates that the extent to which the figures on the sundials match those of one another and of Ptolemy varies considerably. Even concurrence with Ptolemy, it should always be borne in mind, cannot prove reliance on his work, because there is no knowing what consultation of it actually occurred. For some of the cities listed most often, there is striking, all-round concurrence. The figure for Alexandria, listed on seven sundials, is invariably 30 or 31, matching Ptolemy's 31. Similarly the figure for Rome, also listed on seven sundials, is always between 41 and 42, matching Ptolemy's 41 40. There is comparable concurrence for the three cities each listed five times³⁵: the figure for Narbo is always between 43 and 44, matching Ptolemy's 43; Rhodes is always 36, which is also Ptolemy's figure; Syene is always 23.5 or 24, matching

33. None, for example, of the thirty-six sundials of various types recovered to date from Pompeii, or of the five from Herculaneum (including the “ham” portable sundial, no. 2 in Winter's record), is geographical; see Winter (2013), 483–501 (Pompeii) and 371–74 (Herculaneum) respectively.

34. The listings throughout Chapter 2 (which include both Ptolemy's latitude for each location and its correct latitude) amply illustrate the point.

35. For the present purpose I include Narbo and Rhodes in this group as cities.

Ptolemy's 23 50. The variance for Tarsus—listed four times, and placed by Ptolemy at 36 50—is just a degree and a half, between 36.5 and 38. For Constantinople (listed six times), the variance is 2.66 degrees—between 40.33 and 43—and Ptolemy's figure is 43 05. The variance for Thessalonica (listed five times) extends to 3 degrees—40 to 43—and Ptolemy's figure is 40 20. For Constantinople and Thessalonica, therefore, some of our compilers chose a figure close to Ptolemy's, while others chose one appreciably different.

For provinces and regions, the single figures of the lists are typically within the range of the northernmost and southernmost latitudes stated by Ptolemy, even though wide variations may occur in the compilers' choices. For example, Africa and Spain are both listed seven times, with the figure for the former varying by as many as 11 degrees (31 to 42), and for the latter by 7 degrees (35 to 42); in Ptolemy's *Geography*, the province of Africa extends through just over 8 degrees (25 to 33 20), and Spain through 10 (36 to 46). Between them, the sundials list Gaul seven times with figures between 42 and 48, Pannonia (including Superior and Inferior) six times between 44 and 49, Mauretania five times between 34 and 41,³⁶ Sicily five times between 35 and 41, Cappadocia four times between 34 and 43,³⁷ and Palestine four times between 32 and probably 36.³⁸ Among all these spreads, only the lowest figure for Cappadocia, as well as the highest ones for Mauretania and Sicily, are far beyond Ptolemy's range in each instance. Such wide variations among the single figures chosen for all these provinces or regions on the sundials are surprising perhaps in the case of Sicily with its limited north-south span, but only to be expected of others—Gaul especially—that are immense and stretch so much further.

The *lack* of variation that emerges elsewhere seems remarkable, therefore. Most striking is the case of Italy, listed eight times, always with the figure 42 or 43, even though it spans many more latitudes—according to Ptolemy, seven (38 to 45). For Egypt too, listed five times, the figure chosen varies only between 30 and 33, although it in turn extends through as many latitudes as Italy, according to Ptolemy (23 50 to 31 20). Admittedly, on the Rome and Oxford sundials a figure for Egypt lower than 30 might hardly be expected when that is the lowest latitude in the range marked out on the obverse in these two instances.³⁹ The figures for Germania (including Superior and Inferior), listed seven times, diverge between no more than 49 and the low 50s.⁴⁰ Similarly, the figures for

36. I leave out of account the figure 30 (a slip?) on the Rome sundial.

37. I leave out of account the figure 31 on the Oxford sundial.

38. This is to regard the figure 38 on the Science Museum sundial as a likely slip for 32. According to Ptolemy by contrast, Palestine extends for just under two latitudes.

39. The Oxford sundial does mark the 0-degree and 90-degree points, but with no divisions below 30 or above 60.

40. This is to assume that the incomplete figure on the Time Museum sundial was in the low fifties at most.

Pentapolis, listed four times, are all 31 or 32 (and 31 to 31 40 in Ptolemy). Of the four listings for Thrace, there is no question that at least three compilers all chose the figure 41, and it is possible that the compiler of the Memphis list did so too. Even the alternative possibility on that sundial, 44, still falls within Ptolemy's range of 40 40 to 44 40 for Thrace.

There can be little doubt that in five cases the compilers made latitude their organizing principle for listing the names they chose (British Museum, Memphis, Mérida, Time Museum, Vignacourt). The same principle seems to have been applied on three further sundials (Crêt-Châtelard, Rome, Science Museum), as well as partially on a fourth (Oxford). In addition, in the exceptional case of the Philippi sundial, one of the principal criteria for the selection of the four cities Alexandria, Rhodes, Rome, and Vienne must have been latitude, above all the fact that there was reckoned to be an approximately 5-degree interval between each pair of these cities. In no other case, however, is there reason to think that methodical coverage of successive latitudes in this way served as a criterion for the choice of names to include. Thus it evidently did not concern the compiler of the Vignacourt list, for example—comprising twenty-three names within a range fixed at latitudes 30 to 60—that no name at latitudes 31, 32, 36, 38, or 39 is included, while there are two names at each of several higher latitudes and as many as four at 46.

The Time Museum and British Museum lists both demonstrate flawless adherence to latitude as the organizing principle for their names.⁴¹ Almost the same may be said of the Memphis list if (as seems plausible) there is a slip in its figures for both Carthage and Thrace; even so, Apamea at latitude 39 remains out of order here, an exception discussed in the next section below. Although the Vignacourt and Mérida lists, too, are nearly flawless in adhering to latitude as their organizing principle, again each departs from it once. In the Mérida list the departure is the placement of Narbo (43.5) after Tarraco (44) rather than before it, an arrangement that seems to bring no gain and may possibly reflect mere carelessness. In the Vignacourt list, by contrast, the placement of Belgica (48) out of order at latitude 46 serves to group it with two other Gallic provinces, Aquitania and Lugdunensis. The shift may therefore be an indicator of the compiler's worldview, which is a topic for discussion in section 6 below.

On the Science Museum sundial there are in effect two lists: the longer (Syene through Dalmatia) is clearly organized by latitude, and the same may be said of the shorter (Dorakin to Ascalon, a regional group of names), if my proposals for the perception of several slips and their correction made in Chapter 2 are accepted. The latter condition also applies with regard to the nearly identical lists of the Rome and Crêt-Châtelard sundials. Should my proposals for them be accepted, then these lists too appear to be organized by latitude for the most part, although the blatant misplacement of Arabia in both defies explanation;

41. For discussion of the relationship between these two lists, see Chapter 4 section 1 below.

in the Crêt-Châtelard list, Africa is also placed out of order. If the Oxford sundial's names may be divided into three lists as proposed in Chapter 2—a group of six names originally, supplemented by sixteen names as well as by eight—it becomes clear that the sixteen are organized by latitude, but the six and the eight are not.⁴²

4. Distinguishing Homonymous Cities

Another manifestation of the fundamental importance of latitude to compilation of the lists, as well as to efficient functioning of the sundials in accordance with the wishes of their designers or owners, emerges starkly in the handling of cities with a common name. As it happens, the instances all occur in Greek lists,⁴³ where the latitude figure accompanying the name furnishes the only clue to which particular city is meant; even then it may not in fact suffice to resolve uncertainty about what the compiler or owner had in mind. In the *Geography*, Ptolemy repeatedly indicates awareness of such possible instances by his inclusion of commonly used distinguishing eponyms like “Apameia Kibotos,” “Pisidian Antioch,” or “Caesarea Panias.”⁴⁴ The sundials' lists, however, never include any such supplementary noun or adjective for cities,⁴⁵ and there was indeed no pressing reason for them to do so if they were intended for merely private use. An awkward obstacle that we face today whenever we seek to determine the intended choice in any of these instances is the absence of reliable criteria. The natural temptation is to be guided by how close a latitude figure comes to the correct latitude, but this may prove a flawed method in view of antiquity's lack of a set of recognized correct figures and the unpredictability of what latitude was favored by one compiler or another in any instance. Equally troubling is the possibility that we may be no more than dimly aware, if at all, of the city that a compiler had in mind. For example, to us Neocaesarea 44 on the British Museum sundial (latitude 41 50 in Ptolemy; correct latitude 40 30) seems most likely to signify Neocaesarea in Pontus. Even so, another Neocaesarea is attested in the general vicinity of Hadrianoi in Phrygia (*BAtlas* 62 A2). Although its site remains as yet unlocated, its correct latitude too would be

42. The latitude figure 40 for Mauretania is to be regarded as a slip for 41, as explained in Chapter 2 no. 7 above.

43. Overall the Greek lists contain a higher proportion of cities to regions than the Latin lists; compare Maps G.1 and G.2, and see further Chapter 4 section 2.

44. *Geog.* 5.2.25; 5.4.11; 5.15.21 Stükelberger.

45. As observed above, some names of provinces include the adjective Upper or Lower, but the adjective forms an integral part of these names rather than serving as just an optional supplement for clarification. This said, my view is that exceptionally in the Mérida list the occurrence of the single adjective *SVPERIOR* requires Britannia to be understood; see further section 5 of this chapter.

around 40, and at least in Late Antiquity it was evidently a city of some note; so it cannot be ruled out as the compiler's choice.⁴⁶

Given these uncertainties, it may be rash to endorse scholars' assumption to date that Antioch 39 in the British Museum and Time Museum lists refers to Syrian Antioch (latitude 35 30 in Ptolemy; correct latitude 36 10). Rather, Antioch 39 here is surely more likely to refer to Pisidian Antioch (latitude 39 15 in Ptolemy; correct latitude 38 20), especially in the British Museum list, which already includes Coele (Syria) at latitude 36.⁴⁷ However, in view of the figures it seems justifiable to take Antioch in the Aphrodisias (35.33), Memphis (35.5), and Science Museum (36) lists as Syrian Antioch; none of these three lists, as it happens, includes the names Coele or Syria. Again, it would appear reasonable to identify the Caesarea in the Memphis and Science Museum lists (at latitude 32 in both instances) as the Caesarea in Palestine (latitude 32 30 in Ptolemy, which is its correct latitude), and likewise the Neapolis in the Memphis list (latitude 31.66) as Palestinian Neapolis (latitude 31 50 in Ptolemy; correct latitude 31 30). By contrast, what seems to be that name on the Vienna sundial disc 3 obverse is most plausibly taken as Campanian Neapolis in Italy (modern Naples). Again in the Memphis list, Berenice 23.5 between Syene and Memphis surely has to be the port on Egypt's Red Sea coast rather than the city of this name in Cyrenaica much further north (*BAtlas* 38 B1).

On the Samos sundial, identification of as many as three of the twelve city names—Apamea, Heraclea, Laodicea—presents a challenge. Laodicea 38, listed between Rhodes and Ancyra, is hardly to be taken as a Syrian city of that name, given that most names on this sundial are cities in western Asia Minor or near it. For this reason, Laodicea ad Lycum (latitude 38 40 in Ptolemy; correct latitude 37 50) does seem the more likely of the two possible Laodiceas in Asia Minor. Even so, Laodicea Katakekaumene (latitude in Ptolemy 39 40; correct latitude 38 10), remoter but still situated between Rhodes and Ancyra and less far to the east than the latter, cannot be ruled out. In addition, consideration of Ptolemy's latitude for it carries little weight in view of the differences from his figures to be seen throughout this list. Again, because of its placement in the list, Apamea 41 would seem to be taken more plausibly as Bithynian Apamea (latitude 42 00 in Ptolemy; correct latitude 40 20)⁴⁸ than Apamea Kibotos in Phrygia (latitude 38 55 in Ptolemy; correct latitude 38 00),⁴⁹ let alone Apamea in Syria.

Most puzzling of all in the Samos list, however, is Heraclea, for which the figure seems to be 40.33. Simply to follow the unchallenged assumption that

46. See *BAtlas Directory*, p. 970, and *IK 33 Hadrianoi und Hadrianeia* (1987), pp. 137–39, 146.

47. In the Time Museum list, too, there is a strong possibility that Coele (Syria) is the illegible name at latitude 36.

48. *BAtlas* 52 D4.

49. *BAtlas* 65 D1.

Heraclea Pontica is meant (latitude 43 30 in Ptolemy; correct latitude 41 20) might be overhasty when this list postdates the establishment of Constantinople, by which time the former Perinthus not far to the west (latitude 42 20 in Ptolemy; correct latitude 41 00) had been renamed Heraclea and made the capital of the Tetrarchic province Europa.⁵⁰ Even Heraclea Lyncestis in Macedonia (latitude 40 40 in Ptolemy; correct latitude 41 00) merits consideration as a possibility. I am inclined to favor the former Perinthus, in part because that choice permits some logic to be discerned behind an otherwise seemingly random ordering of the twelve names on this sundial (discussed in section 6 below). There can be no certainty, however. It is also conceivable that in the cases of both Laodicea and Heraclea the compiler knew there to be two, or even three, cities of the same name situated at much the same latitude, and was consequently aware that a single listing of such a name would prove doubly useful or more. To an informed private user, after all, such a name did not have to signify just a single city. None of our lists, it may be added in this connection, offers an instance where the same city name is listed more than once, each time with a different latitude figure (not that confusion on our part would necessarily thereby be resolved).⁵¹

Three further comparable instances of uncertainty on the Memphis sundial should be mentioned in addition to Antioch, Caesarea, and Neapolis already noted above: Apamea 39, Edessa 43, and Heraclea 41.66. Apamea at latitude 39 is more naturally taken to signify Apamea Kibotos in Phrygia than the Bithynian Apamea, which (as argued above) the compiler of the Samos list probably intended. However, it is at least conceivable that the compiler of the Memphis list, too, had Bithynian Apamea in mind, but nonetheless inattentively copied the latitude figure for Apamea Kibotos in Phrygia from whatever source was consulted, and the slip was not caught before the list was engraved. For Heraclea—given the latitude figure 41.66 and the fact that the compilation of the list postdates the establishment of Constantinople—all the same possibilities and arguments just rehearsed for the Samos sundial apply. At least Heraclea Pontica seems a doubtful choice in the Memphis list, when Heraclea 41.66 and Ancyra 42 are separated here by only one name. Compilers' geographical awareness and the extent to which they mentally related the names on their list one to another are matters for discussion below, but it would seem to be a very ill-informed or unmethodical compiler who failed to register that Heraclea Pontica on the Black Sea coast is situated north of Ancyra rather than south of it. Otherwise, I see no decisive indication of which Heraclea (Lyncestis, former Perinthus, or some other unsuspected one) the compiler of the Memphis list had in mind. For Edessa 43, the city of that name in Macedonia seems the likely choice (correct latitude 40 45). Without question, this latitude figure 43 is

50. *BAtlas* 52 B3; *BNP* s.v. Perinthus.

51. It is true that both NARB 43 and NARB 44 are listed on the Oxford sundial, but whatever the compiler(s) had in mind here, it can hardly have been two different cities.

seriously awry, but similar inaccuracy is to be found in the figures for Thessalonica and Constantinople. Moreover, were Mesopotamian Edessa to be meant (correct latitude 37 10),⁵² the inaccuracy would be doubled.

5. Comparative Frameworks and Orientation

Although the spatial awareness and worldview manifested in the geographical portable sundials as a whole (including those offering names but not latitude figures) are inevitably a challenge to recover, at the least three shared perceptions emerge clearly enough. First, by definition, integral to the use of latitude as a means of reference is a perception of the world with a north-south or south-north orientation. Second, it is impossible to doubt that the names chosen by the compilers for the limited lists on these sundials furnish only a glimpse of a considerably fuller and more varied geographical awareness. Not only would the compilers have known of further provinces, regions, and cities by one means or another, but their worldview must have encompassed physical features in plenty too, which it was evidently the convention for the lists on these sundials to ignore. To what extent the compilers mentally related even the listed locations to one another—let alone to a fuller worldview—is unclear and calls for discussion. They surely had some desire and ability to envisage these relationships, although this is not to say that their vision was accurate. Third, however, at least it is clear that in almost all cases the compilers used the provinces of the Roman empire as one basic means of articulating spatial awareness.

Our difficulty in seeking to penetrate the compilers' awareness is that ancient tools and frames of reference vital for the purpose are for the most part lacking. Above all, during classical antiquity there never developed a commonly shared set of conventions for representing the world of the type that we today have long taken for granted. In addition, surviving ancient maps are pitifully few in number and their designs of minimal help for our purpose. The so-called Peutinger Map (named after its sixteenth-century German owner) is best known and undoubtedly Roman in origin, although only a single copy survives, not quite complete, made around 1200 (Fig. 3.1).⁵³ It is certainly large and extensive in scope, spanning the Atlantic Ocean to India, but latitude is virtually eliminated from its design, because the frame within which this worldview is presented with a notionally north orientation reduces the north-south dimension to a mere 33 cm in height (see further Chapter 4 section 4). In order to accommodate the landmasses, the design then freely reconfigures them to spread for a length of well over 7 meters, with vast expanses of open water

52. *BAtlas* 67 H2.

53. See Talbert (2010a), with the map itself at www.cambridge.org/9780521764803 Map A.

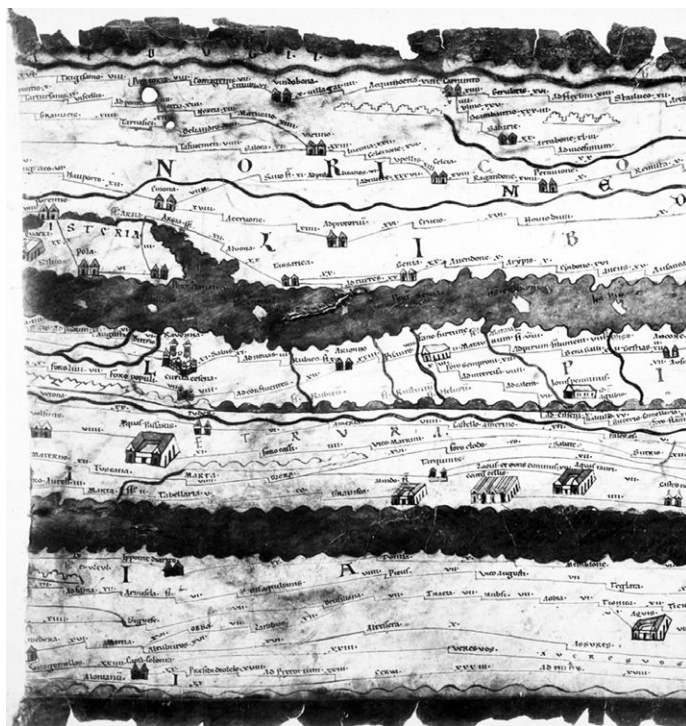


FIGURE 3.1 Peutinger Map: in this part of Segment 4 the Danube river runs along the top, the Roman province of Noricum is prominently named in red, and stretches of open water (the compressed Adriatic and Mediterranean Seas) divide Italy from Africa. On Italy's (upper) Adriatic coast, Ravenna is marked to the left with an elaborate vignette, and Ancona to the far right. Now in the National Library of Austria, Vienna (*Cod. Vindob. 324*).

Photo: *Peutingeriana Tabula Itineraria in Bibliotheca Palatina...* (Vienna, 1888), and Ancient World Mapping Center.

removed (in the Mediterranean Sea especially). Although it is reasonable, if not essential, to infer that creation of such a design must derive from latitudinally based representations of the known world,⁵⁴ these are now all lost. The very different rendering that survives as the Peutinger Map stands out as a drastic departure from the perspective of anyone preoccupied with the latitudes of cities, provinces, and regions.

Another map, complete but far smaller, that may also be ancient in origin survives through a copy thought to have been made in the early to mid-eleventh century (Fig. 3.2).⁵⁵ This rectangular (21 cm high x 17) "Anglo-Saxon" or "Cotton" world map, oriented east, similarly shows no concern for latitude. Its names are

54. Ptolemy himself can be reckoned to have derived many of the coordinates listed in his *Geography* from such maps; see Jones in Talbert (2012a), 122–23.

55. Cotton Tiberius B.V Part I, f. 56v, in Patrick McGurk et al. (eds.), *Early English Manuscripts in Facsimile*, vol. XXI (1983), 33 (date), 79–87 (description by P. McGurk).

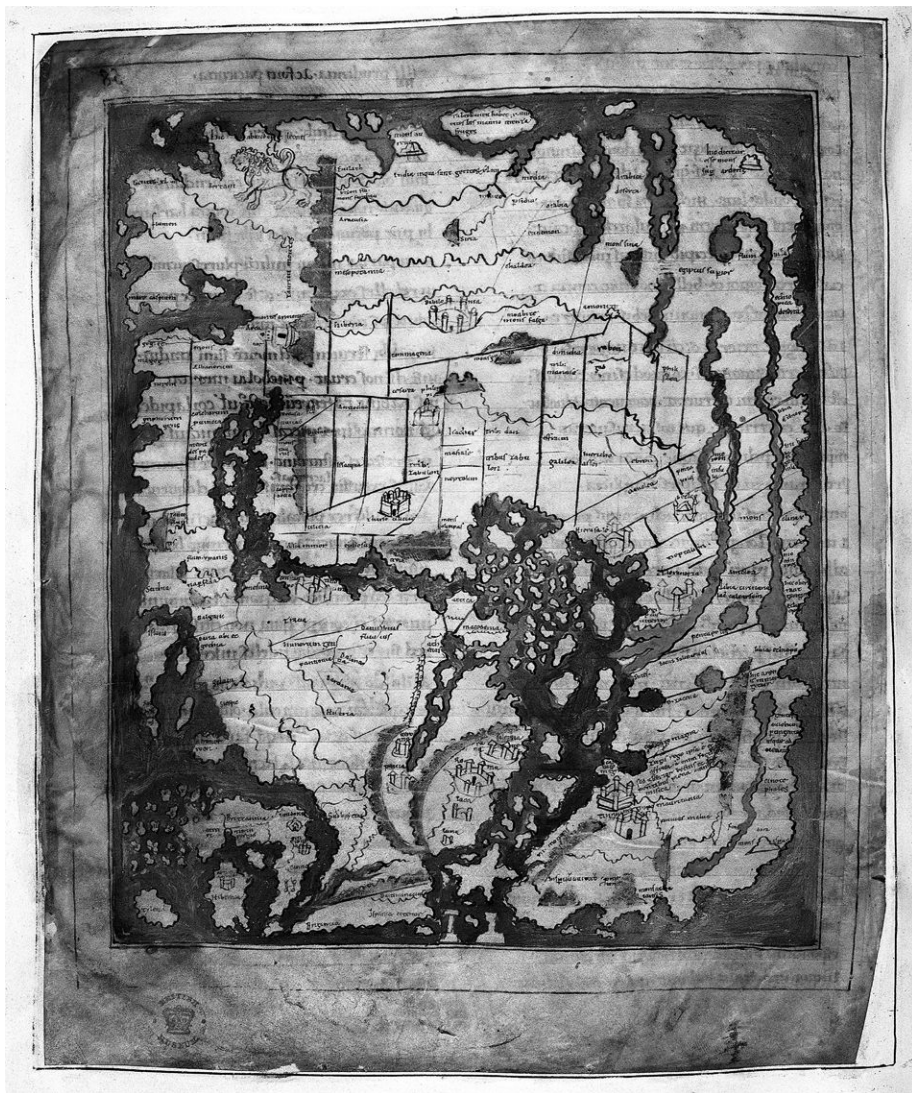


FIGURE 3.2 “Anglo-Saxon” or “Cotton” world map, now in the British Library. India is named top center, and Babylon(ia) appears as a prominently walled city not far below; Britain is at bottom left.

Photo: The British Library Board, Cotton Tiberius B.V Part 1, f. 56v.

a curious jumble, including what Patrick McGurk describes as “a haphazard and badly arranged selection of provinces and cities in Asia Minor.”⁵⁶ For all this confusion, however, a striking feature overall is the presentation of so many names of Roman provinces with their boundaries demarcated by straight lines. If nothing

56. Ibid., 84.

else, therefore, this map reinforces a visualization of the Roman empire as a group of provinces in relation to one another and to Italy. This is a visualization that the geographical portable sundials have in common with a great variety of other ancient source materials.⁵⁷

Whether one or another compiler of the lists on these sundials had a north or south orientation in mind is hard to determine. It is especially puzzling in the case of those sundials where names and figures in a circle occupy the entire disc, with no free space remaining (and thus no other component there), and no explicit indication of where any user consulting the list should begin. This is the style of presentation on eight sundials: Aphrodisias, British Museum, Crêt-Châtelard, Memphis, Oxford, Rome, Samos, and Time Museum. A user who cared to check whether the listing was in order of latitude, and reckoned that it was, could then look for where the lowest and highest figures were adjacent, and perhaps expect that this was the most advantageous point at which to begin, moving in either direction. Such a search for the highest and lowest figures was no doubt just a little quicker on the sundials where the figures are all clustered around the center, than it was on those (Aphrodisias, British Museum, Samos) where the figures occupy the outer edge. The layout of the lists on the Mérida, Science Museum, and Vignacourt sundials is different. On all three, as it happens, the lists are (broadly speaking) in order of latitude, *and* there are distinct breaks at the highest and lowest figures, so that not only is the presentation clearer, but users are also still left free to proceed in either direction. The compiler of the Mérida sundial's list possibly regarded **BRITANN INF 57** as a starting point, because the next name is merely **SVPERIOR 54**, with Britannia understood.⁵⁸ Even so, there is no knowing whether the orientation that the compiler had in mind was to the south or to the north. As with all the other lists, however, in practice this did not matter to users. Their preferences could be accommodated without difficulty, and thus compilers' apparent—perhaps even deliberate—disinterest in providing guidance was to their benefit.

6. Latitude and Worldview

There is the further issue to be addressed of how far a compiler did conceive of a list as a whole and showed concern to relate the names in it one to another. Given the readily identifiable individual character of most of the lists (discussed

57. See R. J. A. Talbert, "Rome's Provinces as Framework for World-view," in Luuk De Ligt et al. (eds.), *Roman Rule and Civic Life: Local and Regional Perspectives* (2004), 21–37; id., "Worldview Reflected in Roman Military Diplomas," in Klaus Geus and Michael Rathmann (eds.), *Vermessung der Oikumene* (2013), 163–70; and further section 6 of this chapter.

58. In principle, if the list is read in the opposite order, **SVPERIOR** might alternatively relate to the next name **GERMANIA**; that is unlikely, however, when the compiler chose not to list an **INFERIOR** German province.

further below and in the next chapter), we are surely justified in believing that they *do* represent considered selections of names rather than random assemblages. The level of geographical conception and linkage that underpins them proves harder to gauge, however. One distinct sign of such thinking, already observed above, is the placement of the province Belgica (48) out of order at latitude 46 in the Vignacourt list so that it appears grouped with two other Gallic provinces, Aquitania and Lugdunensis. Yet even if this explanation for the shift of the name is correct, we may note that the same compiler—consciously or unconsciously—rejected the opportunity to repeat such a step by transposing Callecia (44) and Narbo(nensis) (43), so that in consequence the former would immediately follow Spain and the latter would be grouped with the three other Gallic provinces. Instead, the compiler did not deviate again from maintaining order of latitude as the organizing principle for the list. Rather, the different principle was applied just once, and only then perhaps because Belgica (where the sundial was found) was the owner's "home" province. Similar undeviating adherence to order of latitude as the priority is apparent in other instances, too, where a transposition would improve geographical coherence in the sequence of names. Thus the Memphis list transposes neither Argos 36.5 and Syracuse 37, nor Thrace 41* and Aquileia 45. Further, in both the Rome and the Crêt-Châtelard lists the sequence Italy 42—Narbo 43—Ancona 45—Gallia 48 is maintained without transposition of the two middle names. The same may be said of Egypt 33—Spain 35—Babylonia 35—Illyricum 37 in the Crêt-Châtelard list.

Maintenance of the order of latitude in this way could perhaps be taken to denote a lack of concern for the geographical relationship between the names listed and comprehension of it. Equally, the practice might be interpreted as a sign of such familiarity with geography that a confident grasp of the relationship between the names could be taken for granted. This assumption on the part of compilers is again no doubt reflected in those instances where names at the same latitude occur in a list, and no apparent effort has been made to arrange them in the most geographically comprehensible sequence. In the Time Museum list, Macedonia—Galatia—Thessalonica (all 40) is one such instance (with Antioch, probably in Pisidia, the preceding name), and Rome—Italy—Dalmatia—Gaul (42) a second (immediately followed by names in the East). In the British Museum list the same may be said of Coele (Syria)—Sicily—Pamphylia (36), and of Cappadocia—Italy—Constantinople—Gaul—Asia (43). This is not to overlook the fact that more geographically comprehensible sequences do also occur. Observe four: in the Time Museum list, Pamphylia—Greece—Spain (37); in the Science Museum list, Antioch—Rhodes—Athens—Sicily (36); and in the British Museum list, Syene—Thebaid—Libya (24), as well as Rome—Thrace—Bithynia—Abydos (41). To what extent these sequences arise more by chance than by deliberate formulation remains impossible to determine,

however, especially in the cases of the Time Museum and British Museum lists, where a lack of such concern is also to be seen.

If we turn to consider next the geographical accuracy of the compilers' vision on the basis of their latitude figures when the corresponding names are plotted on a map, a more mixed impression emerges; see Maps 2.1–2.14, and compare Maps G.1–G.3. Naturally, restraint on our part is called for. These compilers cannot be expected to meet modern standards, and in any event they are not concerned to furnish longitude figures to match the latitudes they specify.⁵⁹ Even so, it does seem justifiable and informative to identify and assess egregious inaccuracy, as well as instances where the relationship between locations appears to be seriously misunderstood. It was on just such grounds among others that Ptolemy offered blistering criticism of his predecessor Marinus (mentioned above in section 2 of this chapter), finding fault especially with instances where he misunderstood or misrepresented the relationship between locations.⁶⁰ Without doubt, Ptolemy would have also found much in the lists on the geographical portable sundials to comment on. It should be stressed at once that even at worst any list is only partially flawed, so that no entire list is unsatisfactory. Some remarkable contrasts are to be found, however.

Take the Vignacourt list, for example. Here the low figures Asia 33 and Cappadocia 34 situate these provinces—amazingly—south of Judaea 35, while the high figures Mauretania 41 and Africa 40 situate those only one or two degrees south of Spain 42 and Italy 42 (Map 2.11). As it happens, these last two figures are reasonably accurate by contrast, as are many others further north, with the striking exception of the three in succession Moesia 51, Dacia 51, Sarmatia 53. These three do cohere adequately as a group, but they must be visualized very far north. Comparable contrast is to be found in the Oxford list (Map 2.5). Its latitudes for names in Europe are also accurate enough for the most part, although the figures for Sicily 41 and Dacia 52 are both distinctly high. Much the same high figures as in the Vignacourt list recur here for Mauretania 40 (probably a slip for 41) and Africa 41. However, the most serious misunderstandings on the Oxford sundial arise in two sequences of names relating to Asia Minor: Galatia 45—Phrygia 36—Bithynia 35 (three of the sundial's group of eight names), and Lycia—Cilicia—Asia—Cappadocia all with the same figure 31 (four of its group of sixteen). In other words, a mere 1-degree difference between all of the latter four names⁶¹ and Egypt 30 is envisaged, while the latitude given for Galatia

59. As stated at the start of Chapter 2, all my maps merely assume correct longitudes.

60. Note the discussion of Berggren and Jones (2000), 24–25: evidently Marinus paid special attention to identifying locations that were “oppositely situated,” and also offered lists of locations that he believed to be situated at, or close to, particular latitudes.

61. Or three, if 31 for Cappadocia is a mistake by the engraver, as seems likely; see Chapter 2 no. 7 above.

is as many as 15 degrees further north from Egypt 30 as well as 10 degrees *north* of Bithynia 35. Copying errors that elude us may again be part of the explanation, but it would also seem that the source used for latitude figures in compiling the group of sixteen names was not the same as that used for the group of eight. Rather, in all likelihood two sources were used, and they happen to differ considerably in how they situate the regions of Asia Minor. Whoever compiled the two lists of names—whether the same individual or not, in whatever order—did not reconcile the differences.

Two other lists that reflect serious misunderstandings are the related pair Rome and Crêt-Châtelard (Maps 2.1 and 2.4 respectively); in both, Illyricum 37 is situated far *south* of Italy 42 and Africa 42/40; beyond Illyricum, Egypt 33 is situated only 4 degrees further south, and Ethiopia only 3 degrees beyond Egypt. In the Crêt-Châtelard list, Spain 35 is placed well to the *south* of Mauretania 40.5. Although some copying errors without doubt remain uncorrected in this pair of lists too, none is immediately identifiable in the names and figures just cited.

To redress the balance, the Mérida list may be noted as altogether accurate (Map 2.12), although its one misplacement—Tarraco 44 *south* of Narbo 43.5—is unexpected, especially in view of the number of other Gallic and Spanish names chosen. Two further generally accurate lists with an identical extraordinary misplacement are the pair Time Museum and British Museum (Maps 2.8 and 2.13 respectively): in both, the latitude figure for Cappadocia is 43, that is, 3 degrees *north* of Galatia in the former list, and 2 degrees north of Bithynia 41 in the latter. Such misplacement of Cappadocia twice appears all the more surprising if—as seems probable—the compiler of one of these two lists is aware of the other and consciously exploiting the opportunity to improve on its latitude figures (see Chapter 4 section 1). Less extraordinary, but still unexpected, are the low figures in the Science Museum list for Athens 36 (the same as for Rhodes, therefore) and for Ascalon 30, placing the latter city 1 degree *south* of Alexandria (Map 2.10). These are curious misplacements on an unusually complex instrument—custom-made, surely—whose designer or owner had not only a deep engagement with science, but also apparently some special interest in Palestine. We should resist any temptation to propose that, after the single letter lambda (= 30) for the latitude of Ascalon, the engraver merely omitted to add a second letter (thus raising the figure to 31 or higher). Though there is no denying that the engraver did make slips elsewhere in this list and evidently even corrected one, inspection of the line for Ascalon shows the single lambda to be deliberately centered here, with no hint that a further letter should be allowed for.⁶²

Any possible doubt about how far the names in the majority of the lists were meant to be related to one another certainly does not extend to the Aphrodisias

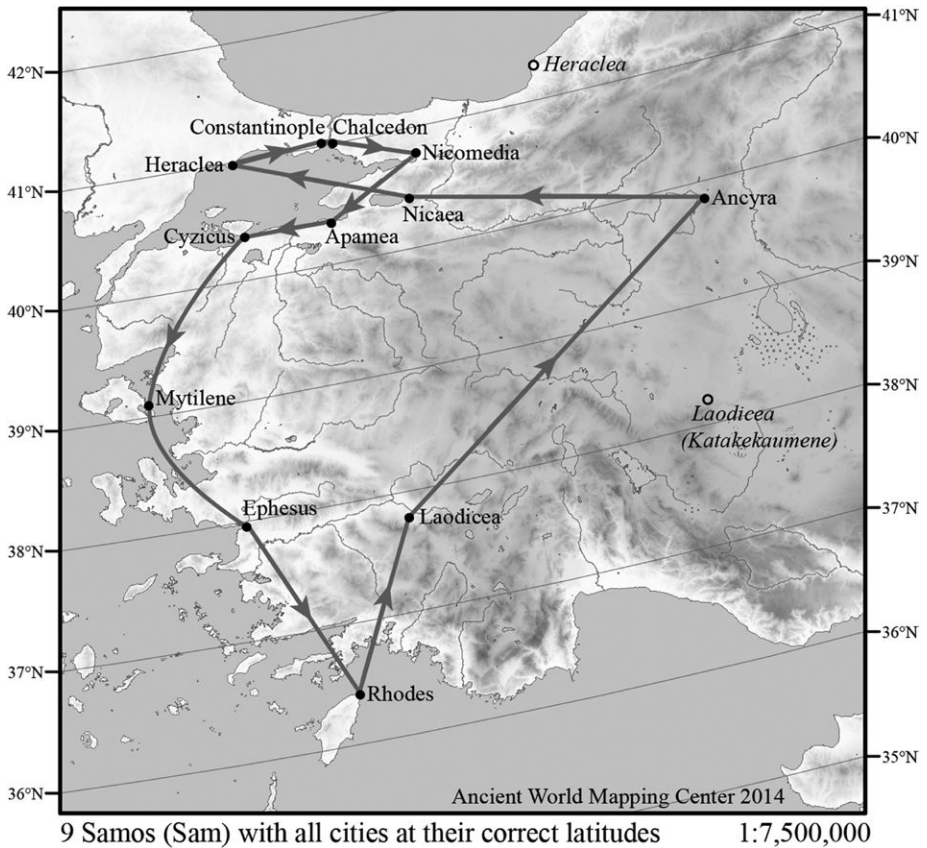
62. Compare the placement of the latitude figures for GERI and BRIT on the Oxford sundial.

and Samos sundials. Here again nothing but names and latitude figures in a circle occupy the entire disc, without indication of where a user consulting either list should begin. Both lists may create the initial impression of being merely random assemblages, therefore, and perhaps they are just that. But one attractive means of countering this impression does present itself, which is to read the names with a deliberate concern to relate each to the next. This approach reveals that both lists offer the bare outline of a *periegesis*, *periodos*, or *periplous*, the traditional Greek terms for a descriptive tour or circuit (imagined or real, by sea or land, or both) of some shoreline, region, and even the entire world.⁶³

The Aphrodisias list is the longer and perhaps clearer of the two in this respect (Map 3.3). In the East its furthest point is Syene, at Egypt's southern border. It next proceeds through Egypt (Memphis, Pelusium, Alexandria) before moving west through Cyrenaica (Pentapoleis) to Carthage. Then it turns back east to Crete, and north through Athens, Thessalonica, Cyzicus, and Nicomedia to Constantinople. From here it traverses Asia Minor through Galatia and Cappadocia to Tarsus, and then on southward through Antioch to (Syria) Phoenice and Palestine. Turning back northwest at this point, it proceeds through Cyprus, Lycia, and Pamphylia to Rhodes, and from here on to Sicily and Rome. The final stretches are from Rome into Gaul, and specifically Burdigala (modern Bordeaux), and then into Spain, with Emerita (modern Mérida) the endpoint. Naturally, the tour can just as well be followed from the opposite direction starting at Emerita, or indeed starting from any point in between. It is presented as an unbroken loop, with no name flagged to attract more attention than any other. Some serious errors of latitude are apparent insofar as the figure for Thessalonica 43 places the city as many as 2 degrees *north* of Constantinople 41; Nicomedia 42 and Galatia 42 likewise place them both *north* of Constantinople. Palestine 36—thus north of both Phoenice and (Syrian) Antioch!—is a similar serious slip (Map 2.6). Even so, it is important to recognize that none of these erroneous latitude figures undermines the interpretation of the list as a tour, because the names still form a viable sequence despite them.

Many of the same points may be made about the Samos list. There is hardly cause to doubt that its relatively limited territorial scope is quite intentional,

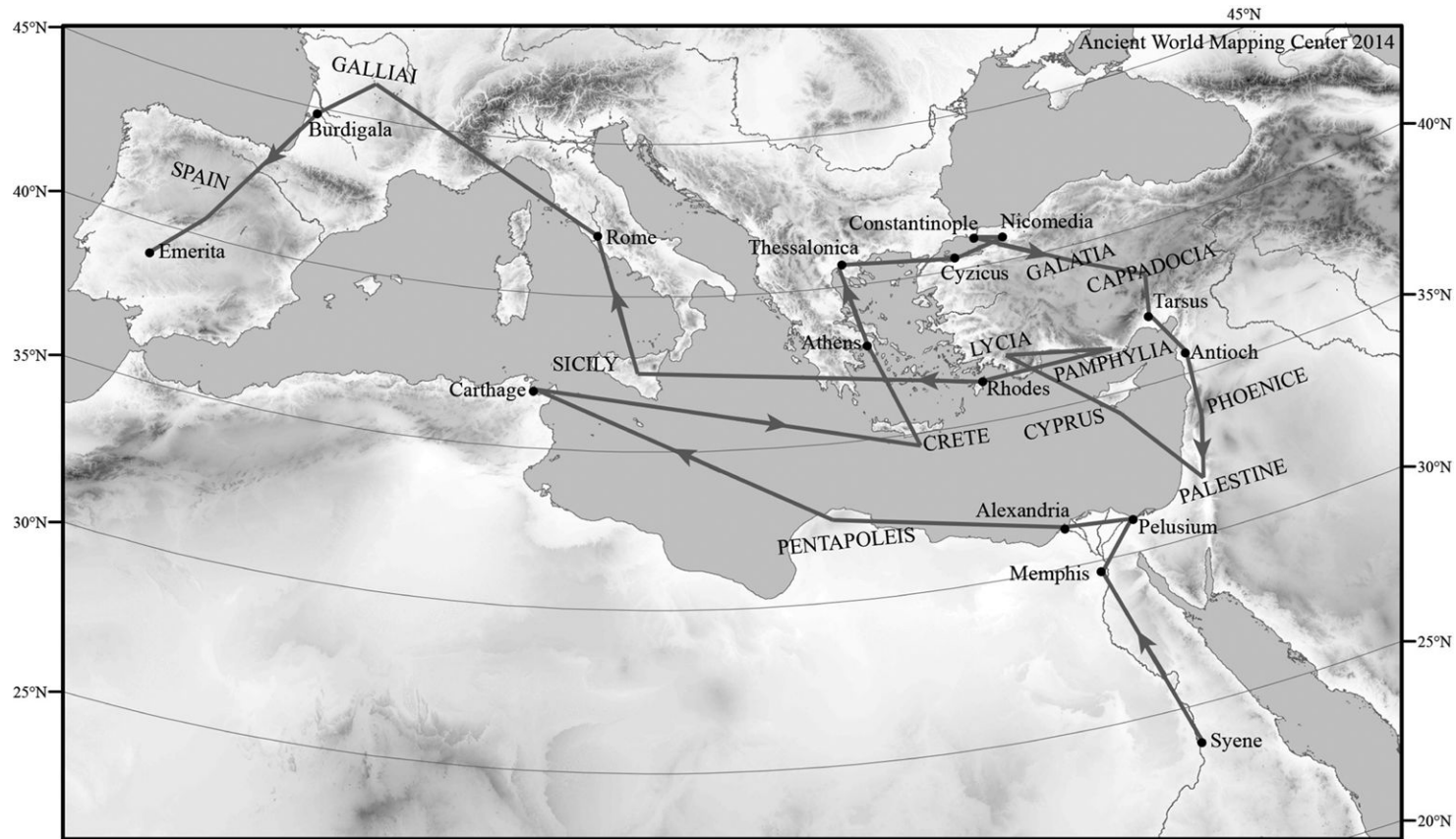
63. See in brief Dueck (2012), 6–7 and ss. vv. in her index; Salway in Talbert (2012a), 195–202; D. W. Roller, *Ancient Geography: The Discovery of the World in Classical Greece and Rome* (2015), s.v. *periplous* in index. J. L. Lightfoot, *Dionysius Periegetes: Description of the Known World* (2014), 13–22, traces the basic clockwise circuit of the Mediterranean starting from the Pillars of Hercules, and variants on it. The latter are considerable in the case of Dionysius, whose description never doubles back on itself, but does repeatedly zigzag north-south as he proceeds from west to east. Two Latin versions of his Greek poem also survive, made by Avien(i)us and the grammarian Priscian in the late fourth and early sixth centuries respectively (ed. Paul van de Woestijne 1961, 1953). For commemoration of a soldier's career in the format of a *periegesis*, see Chapter 4 section 4.



MAP 3.2 Samos, no. 9, with tour route outlined.

Ancient World Mapping Center.

or that its restriction to as few as twelve cities is equally deliberate, when more—Pergamum and Smyrna, for example, not to mention the names of regions—could have been accommodated on the disc without difficulty. Especially if Heraclea is taken to be the former Perinthus (as proposed above in section 4 of this chapter), the seemingly otherwise random dozen names can be read as a tour sequence (Map 3.2). This reading still holds even if Laodicea is taken to be Katakekaumene rather than Ad Lycum, and (though less likely) Heraclea as Lyncestis rather than the former Perinthus. It is certainly surprising that the apparent figure for Nicaea (40.33) locates it *north* of Nicomedia (40), and again that the figure for Apamea (41) locates it north of Constantinople and Chalcedon (seemingly both 40.33). However, as in the case of the Aphrodisias sundial, errors of latitude cannot serve to invalidate interpretation of the Samos list as a tour, because here too the sequence of names remains a viable one.



8 Aphrodisias (Aph) with all locations at their correct latitudes

MAP 3.3 Aphrodisias, no. 8, with tour route outlined.

Ancient World Mapping Center.

In short, the names and corresponding latitude figures listed on the geographical portable sundials create the impression of a confident spatial awareness on the part of their compilers—at least of principal cities, provinces, and regions—matched by a wide-ranging worldview that spanned the Roman empire and beyond to the north, east, and south. Even so, confidence should not be assumed to equate with a wholly accurate grasp, because it emerges on investigation that one or more serious misconceptions can be detected in almost every list. To check each list of names against a map that took latitude and longitude into account might seem a useful precaution for eliminating errors before engraving began, but it is hard to believe that such checks were performed, and of course maps were not invariably accurate anyway. Instead, it would seem, compilers remained content to rely on the worldview that they carried in their heads, one in which the imagined relative locations of the names they chose did not necessarily match the latitude figures specified for them. By the same token, no pressing need was felt to clarify which particular city with a common name was meant in a list. The compiler knew which one, and where it was situated in the mind's eye. This personal awareness sufficed for what was typically intended to serve as a private instrument. It is appropriate therefore that we should turn next to consider the makers and owners of these sundials.

4

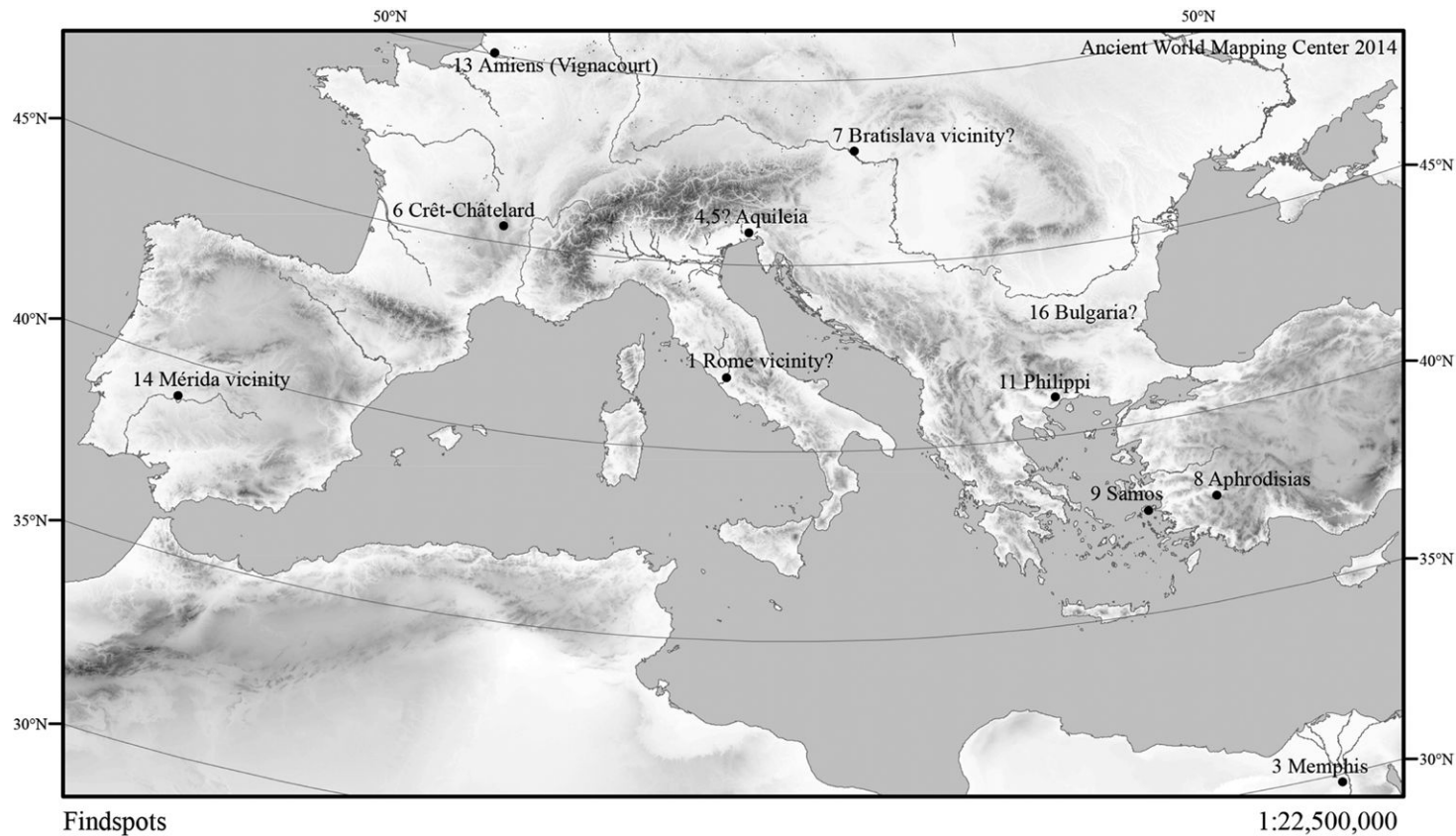
A Community of Dialers?

So, we now ask, in the Roman empire what kind of person would produce or own or use a geographical portable sundial, and for what purposes? The question is a broad, basic one, and this chapter sets out to propose some answers to it, framed only in speculative, anonymous terms though they must be. No such sundial can be linked to a named individual, and no text refers to one in any way beyond Vitruvius' passing mention quoted in Chapter 1 section 3. The potential range of relevant roles—some no doubt fulfilled by the same individual in certain instances—is extensive: commissioner of the instrument, its designer, compiler of the list of names and latitude figures, metal worker, engraver, seller, first owner and subsequent ones, users other than the owner. The contexts, too, in which the sixteen surviving examples were found are altogether less informative than might be hoped. In consequence, a sketch map of findspots can serve as no more than the most general indicator; see Map 4.1.¹ The great majority of these sundials are random finds for which no context, or little beyond the general area, was recorded. A precise, reliable context is known for as few as three, and in no instance does it furnish more than the vaguest pointers for dating the instrument. The Aphrodisias sundial surfaced during the excavation of Late Antique houses in the northeastern part of the city. The Philippi sundial emerged from a sewer in a central area of the city that was not built up until the first half of the fourth century CE. The Vignacourt sundial is a stray surface find made during an investigation of a Gallo-Roman villa site.

By contrast, it so happens that the findspots of both the known cylindrical portable sundials are soundly documented (see Chapter 1 section 3). One was found in northeast Italy among the objects in the well-preserved late-first-century CE tomb of an oculist,² the other retrieved

1. The map leaves out of account the Science Museum sundial, for which the only claim is that its components were purchased in Lebanon.

2. The date at which this sundial was made remains a separate issue, of course. I hesitate to accept the argument for an Augustan date (early first century CE) put forward by Arnaldi and Schaldach (1997), 111.



MAP 4.I Findspots of sundials.

Ancient World Mapping Center.

during excavations of a burial area on the outskirts of Roman Samarobriva (modern Amiens, France) and dated to the first half of the third century CE. Understandably enough, medical specialists generally might value a portable sundial, not only for use when traveling but also for purposes of diagnosis and treatment.³

It is true that, because the cylinder type is limited in range to a single latitude and carries no geographical names, this type remains largely tangential for present purposes. Even so, the prospect that the Samarobriva cylinder sundial⁴ could well have come from a workshop there that produced small items in bone makes it all the easier to imagine nonspecialist engravers routinely accepting commissions to manufacture portable sundials if furnished with instructions, and conceivably a model too, by an informed expert. To what extent any workshop would go to the further lengths of adopting a design and manufacturing copies of it for sale can again only be matter for conjecture, although features of the Rome and Crêt-Châtelard sundials—discussed in the next section below—might suggest some initiative of this kind. Such sundials could presumably be offered either with geographical names and their latitudes already inscribed on the reverse, or with none, affording purchasers the opportunity to specify their own choices to an engraver. The outlay likely to be required of the purchaser of a portable sundial is impossible even to estimate, especially when there were clearly many variable costs.⁵ It seems fair to imagine, however, that a basic portable instrument such as the Crêt-Châtelard sundial would hardly stretch the pocket of an educated (and therefore relatively well-off) individual. At the other extreme there need be no doubt that an elaborate instrument with intricate custom-made features—such as the Science Museum sundial most conspicuously—would be expensive to commission.

3. Kassandra Jackson (University of Chicago) is completing a dissertation “Man of the Hour: Clocks and Hourly Timekeeping in the Galenic Corpus”; for some indication of its scope, see <https://classicalstudies.org/annual-meeting/147/abstract/man-of-the-hour-impact-hourly-timekeeping-galen's-fever-case-histories> (January 2016).

4. Chapter 1 section 3, with Hoët-van Cauwenberghe, Binet, and Thuet (2008), 114. For the workshop (the Rank Xerox site), see Annick Thuet, “Le travail de l’os dans l’antique Samarobriva (Amiens, F): première approche,” 35–45, in Isabelle Bertrand (ed.), *Le travail de l’os, du bois de cerf et de la corne à l’époque romaine: un artisanat en marge?* (2008), at 39 with figs. 2, 4, 5.

5. Among these, choice of material should not be overlooked. For comparison, observe that the celebrated Nuremberg makers of portable diptych sundials during the sixteenth and seventeenth centuries worked in both ivory and various grades of wood; see Chapter 5 section 3, and Lloyd (1992), 33–35 (by Penelope Gouk). Predictably enough, no portable sundials made in wood have survived from antiquity, but wood could surely have been used for the purpose, as bone was for cylinder sundials. Both metal and wood were used for this latter type from the Middle Ages onward, as noted in Chapter 5.

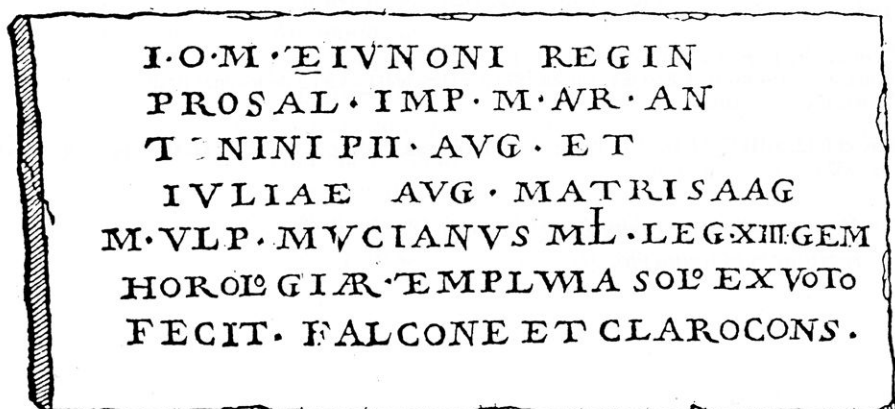


FIGURE 4.1 Inscription recording the dedication of a temple in Apulum, Dacia, by a legionary *horologiarius*. Only this sixteenth-century drawing by Iacobus Bongarsius survives.

Rerum Hungaricarum Scriptores Varii Historici Geographici (Frankfurt: Marnius et Aubrius, 1600), 625.

Specialist designers and makers (whether full-time or not) of sundials all but elude us,⁶ although there is now good reason to think that the Aquincum Fragment discussed in the Appendix documents the expertise and activity—perhaps peripatetic—of one such individual (of unknown status and background). Some of the geographical portable sundials plainly attest to ingenuity on the part of talented, indeed learned, designers, and no doubt even rivalry among them, as discussed in section 3 of this chapter. *Horologiarius* may be an appropriate Latin term for experts of this type, although the term is attested just once, on an early-third-century inscription from Apulum in Dacia (where the legion XIII Gemina was stationed) in the dedication of a temple by a legionary (Fig. 4.1).⁷ The inscription is known only from a drawing, and the syntax lacks clarity; but, by my reading, *horologiarius* is to be understood as the specialty that the legionary claims for himself.⁸

6. A specialist workshop for sundials (fixed or portable) has yet to be found; Bonnini (2015), 173–74.

7. *BAAtlas* 21 F3. There is ample evidence that the Roman army recognized an immense range of specialties among its troops: note, for example, the passage from the *Militaria* of the second-century CE jurist Tarutienus Paternus preserved in *Digest* 50.6.7. The army also had every reason to be concerned with timekeeping, as briefly illustrated by Christophe Schmidt Heidenreich, “L’armée romaine et la mesure du temps,” *Dossiers d’Archéologie* 354 (2012): 76–79.

8. *ILS* 5625 = Ioan Piso (ed.), *Inscriptions d’Apulum (Inscriptions de la Dacie Romaine—III 5)*, vol. 1 (2001), no. 193. I concur with Bonnini (2015), 83, 269, in reading *horologiar* as self-referential, but I see no reason to limit the scope of this specialty to maintenance of sundials. Bonnini (*ibid.*) is willing to credit a second appearance of the term in a Greek inscription now lost; in my view, however, the relevant line (8) as recorded is too damaged to support that reading. See *IK* 10,1 *Museum Iznik (Nikaia)* (1981), no. 726.

1. Time Telling: Margins of Error

Naturally, in principle someone with an interest in a geographical portable sundial sought an instrument that could be adjusted to tell the time accurately at any latitude, wherever the user happened to be across a wide range. Even so, to judge from the surviving examples, we should recognize that just how satisfactorily these sundials would meet this wish in practice is uncertain. To be sure, the concept was sound if the sundial had been produced with appropriate care, but still—as observed above—its ideal fulfillment depended on users first knowing the correct date and the exact latitude of their location, then being able to make the necessary settings on the sundial with corresponding precision, and finally being able to use it in perfectly calm, clear weather. Such hopes would seldom all be realized in antiquity. In particular, the prospect of users determining their precise latitude was slim. Moreover, these sundials were so small in size that the effect of a shift from one degree to the next or even less would be minimal. Although their compactness was undoubtedly a feature that strongly appealed to owners, at the same time it acted to reduce the sundials' effectiveness in practice.⁹

The compactness is truly remarkable. These are objects that can be held in one hand, and even carried with ease by people who would otherwise as a matter of course normally be accompanied by one or more slaves wherever they went, and would expect to have everything carried for them.¹⁰ In the exemplary account of a young pupil's day offered by a Late Roman Latin schoolbook, the items he will need in the classroom are naturally carried there by a slave (*meus puer capsarius*, line 15); his reliance on slaves is in fact constant.¹¹ The Oxford sundial furnishes perhaps the most impressive demonstration of the deft ability to accommodate (just!) as many as thirty names and latitude figures legibly on a miniature disc, one with a diameter of no more than about 6 cm in this instance, designed for use between latitudes 30 and 60. Hence the shift to rotate it through, say, a mere couple of degrees would barely be noticeable. Apart from the not fully comparable pillbox sundial discs—modeled on coins and ranging in diameter from 3 to 5 cm—only the Crêt-Châtelard sundial is more compact than the Oxford one; with a diameter of 5.65 cm, it presents sixteen names and figures. Setting aside the Science Museum sundial as a

9. Compare the popularity of pocket globes among Europeans in the seventeenth to nineteenth centuries; according to Sylvia Sumira, *The Art and History of Globes* (2014), 24, "The pocket globe was a mini-cosmos, a small terrestrial globe enclosed in a fish-skin case lined with celestial gores." See further s.v. pocket globes in her index.

10. Note Horace, *Satires* 1.9, where it turns out that the poet is in fact accompanied by a slave on what he represents to be a solitary stroll; see T. M. O'Sullivan, *Walking in Roman Culture* (2011), 7 n. 17.

11. See A. C. Dionisotti, "From Ausonius' Schooldays? A Schoolbook and Its Relatives," *Journal of Roman Studies* 72 (1982): 83–125.

special case, even the two largest of the sixteen sundials described in Chapter 2, Time Museum and Mérida, extend no further than 12 or 13 cm in diameter. Unfortunately there is no record of the dimensions of the Memphis sundial, which presents as many as thirty-six names and figures, a total matched only by the British Museum sundial. Such skill in compact, neat presentation bears comparison with the names of 106 stopping points on a land route from Gades in Spain (modern Cádiz)¹² to Rome—each name followed by a figure for the number of miles to the next—engraved in four columns around the outer surface of four silver “cups” or beakers unearthed at Vicarello north of Rome.¹³

Naturally, the prospects for users to be able to tell the time accurately would be further reduced in those all-too-frequent instances where they were liable to rely on a latitude figure that—did they but know it, as we do—is seriously mistaken. Indeed, as shown in Chapter 3 section 6 above, in some lists there are sufficient such errors for us to wonder how satisfied owners could have been with their commission or purchase, especially if they took it on actual journeys and tried to use it. To use the Rome or Crêt-Châteldard sundials in Illyricum, for example, setting the latitude at 37 as they both specify (just north of Carthage in fact), would not give best results. The same may be said of using either the Time Museum or British Museum sundial in Cappadocia with the latitude set at 43 (on a level with the northern Caucasus range), and likewise of using the Vignacourt sundial in Mauretania with the latitude set at 41 (where Tarraco, modern Tarragona, is situated in fact). More generally in any case, the convention of furnishing only a single figure for provinces or regions that extend through several latitudes—such as Britain, Egypt, Gaul, Italy, Spain—was liable to reduce accuracy. It is true that the evidently agreed figure for Italy, 42 or 43, is more or less midway between its northernmost and southernmost latitudes, but in other instances there is typically more variation and the choice may veer to an extreme. The figure for Egypt is never lower than 30, although the province in fact extends south to latitude 24. Latitude 42 or 43 for Gaul is extremely low, at the Pyrenees or even south of them in fact. At another extreme, latitude 57 for Britain is further north even than the Antonine Wall¹⁴ and thus beyond the limits of Roman occupation at any date.

Various explanations can be put forward for owners’ apparent tolerance of inaccurate latitude figures. Like the designer of the Philippi sundial, they may

12. *BAAtlas* 26 D5.

13. See *CIL* XI.3281–84, with J. M. Roldán Hervás, *Itineraria Hispana: Fuentes antiguas para el estudio de las vías romanas en la Península Ibérica* (1975), 154–57 and Lám. XIV–XXI. The four cups differ slightly in size from one another; the largest measures 15.3 cm tall, with a diameter of 7.7 cm, and the smallest 9.5 cm tall, diameter 6.8 cm. Equally, no cup’s set of names and figures is quite identical to any other. All four cups are displayed by the Museo Nazionale Romano, Palazzo Massimo, Rome.

14. *BAAtlas* 9 C5–D5.

well have realized that the results to be obtained would in any event not vary markedly from one degree to the next (nor from day to day), so that precision for this setting of the sundial was not always vital. Among fixed sundials recovered from the classical world, too, it is by no means rare to find one used in a location situated at a latitude far removed from that set by the designer. We learn that in one notorious instance a sundial produced for use at Catania in Sicily¹⁵ was moved to Rome in 263 BCE and used there for a century without complaint.¹⁶ The difference in latitude between Catania (37° 30') and Rome (41° 50') means that Rome's day (sunrise to sunset) is about half an (equinoctial) hour longer in midsummer than Catania's, and shorter by the same period in midwinter. But when that difference is divided by twelve for equal hours, it amounts to no more than about 2.5 minutes for each such hour, more or less, according to season. So slight a difference would barely register on a small portable sundial, even though Catania and Rome are more than four degrees apart. As we shall see in Chapter 5 section 3, centuries later this practical point no doubt came to be recognized again by the makers of ivory portable sundials at Nuremberg. From the early sixteenth century, they produced an adjustable type that offered the opportunity to tell the time at different latitudes, but often with settings at three-degree intervals only, rather than making it possible to set any latitude within a range.

Given Roman owners' apparent tolerance of inaccurate latitudes, the argument might be made that the very concept of latitude was of minimal interest to them. Such a claim would be too dismissive, however. For all their tolerance of inaccuracies, owners with a serious interest in sundials could hardly forget that attention to latitude is fundamental to the effective functioning of all such instruments. More specifically, there are clear signs to be found of preoccupation, not to say obsession, with latitude. In most instances where we are able to inspect the marking of degrees of latitude on obverses (and on the Aquincum Fragment discussed in the Appendix), the interval is 6 degrees or less. In fact the Crêt-Châtelard, Memphis, and Rome sundials, as well as the Aquincum Fragment, mark every 2 degrees (Memphis and Rome for only part of the range); Science Museum, a *de luxe* product, marks every single degree. It is curious that the Samos sundial, though enumerating every 6 degrees, should dispense with line work to mark the intervals. The Oxford sundial, however, is exceptional in marking no more than 10-degree intervals, and even those only between 30 and 60.

A further sign of preoccupation with latitude is the inclusion of a fraction in a latitude figure, even though the designer, and probably the owner too,

15. *BAAtlas* 47 G3.

16. See Hannah (2008), 750, and (2009), 135 and n. 65. For further discussion of such relocations see, for example, Denis Savoie, "Le cadran solaire grec d'Al Khanoum: La question de l'exactitude des cadrans antiques," *CRAI* (2007): 1161–90; id., (2014), 17–31, 48.

must have realized that there was no realistic prospect of improving the sundial's operation by this means. All the same, a demanding owner might want nothing less than the best, fullest data, and a designer could take pride in supplying it. Unarguably most impressive in this connection is the Memphis list. Here as many as fourteen or fifteen of the thirty-six latitude figures are given to a fraction of a degree (all of them for cities)—to half in eight instances, and to two-thirds in six instances, although there is reason to think that one of these latter fractions (for Carthage) could be a slip for one-third; in addition, it remains possible that the one missing latitude figure included a fraction. No less impressive is the Samos list (all cities) if my readings are right: of its ten fully legible figures (out of twelve total), six evidently include a fraction (one half and five thirds). Insofar as the figures for at least eight of the twelve cities in this list place them within a mere two-degree range (latitudes 40–41), there is some point to the inclusion of fractions here.

Likewise remarkable is the Aphrodisias list, where eleven of the twenty-eight figures include a fraction—eight to half a degree, and three to one-third. Twice in the circle of names here, as it happens, four names with a fraction appear in succession. Seven of the eleven fractions in total occur in figures for cities, but two of the halves are for provinces or regions (Cappadocia, Pamphylia), as are two of the thirds (Lycia, Phoenice). The only other Greek sundial to include a fraction is Philippi, where the latitude for Rome is given to two-thirds of a degree, matching Ptolemy's figure in the *Geography*. None of the Latin lists shows a comparable predilection for fractions, perhaps because—as noted further in the next section below—they include distinctly fewer cities than regions, and their compilers may have frankly acknowledged that fractions for the latter have even less value than they do for cities. Even so, Crêt-Châteland's figure for Mauretania is to half a degree, while the Mérida list similarly gives figures to half a degree for Narbo, Sarmatia, and Pannonia Superior, in this last instance maybe in order to distinguish it more explicitly from Pannonia Inferior.

Preoccupation with latitude is the most noteworthy finding to emerge from a comparison of the Time Museum and British Museum lists. Both are organized by latitude, and they show a surprising amount in common; see Table 4.1. It could even seem that one compiler was deliberately reacting to the choices of the other in a critical fashion. If so, on balance it is perhaps more likely that the British Museum compiler—able to fit thirty-six names and figures facing outward on the slightly smaller of the two discs—critiqued the Time Museum list (thirty names and figures facing inward), but the reverse is also conceivable. The critique also embraced the names in this list: differences can be seen in the spelling and case of several names, and some rearrangement of their order is called for, at the higher latitudes especially. Nonetheless, the differences of this type are relatively minor. The same may be said of the two substitutions of Achaia 37 for Hellas 37 and Britannia for Germania, and even

Table 4.1

10 Time Museum

ΜΕΡΟΗΣ	ΙΣ	Meroe	16
ΣΟΗΝΗΣ	ΚΔ	Syene	24
ΘΗΒΑΙΔΟΣ	ΚΗ	Thebais	28
[.]ΙΓΥΠΤΟΥ	ΛΑ	Egypt	31
[...]ΝΤΑΠΟΛΣ	ΛΑ	Pentapolis/-eis	31
ΑΦΡΙΚΗΣ	ΛΒ	Africa	32
ΠΑΛΑΙΣΤΙΝ	ΛΒ	Palestine	32
ΜΑΥΡΙΤΑΝΙΑ	ΛΔ	Mauretania	34
ΚΥΠΡΟΥ	ΛΕ	Cyprus	35
ΣΙΚΕΛΙΑΣ	ΛΕ	Sicily	35
Ϛ	Λς	[Coele (Syria)?]	36
ΠΑΝ[...]ΥΛΙΑΣ	ΛΖ	Pamphylia	37
ΕΛ[...]ΑΔΟΣ	ΛΖ	Hellas	37
ΣΠΑΝΙΑΣ	ΛΖ	Spain	37
ΤΑΡΣΟΥ	ΛΗ	Tarsus	38
ΑΝΤΙΟΧΙΑ	ΛΘ	Antioch	39
ΜΑΚΕΔΟΝΙΑ	Μ	Macedonia	40
ΓΑΛΑΤΙΑΣ	Μ	Galatia	40
ΘΕΣΣΑΛΟΝΙ	Μ	Thessalonica	40
ΘΡΑΚΗΣ	ΜΑ	Thrace	41
ΡΩΜΗΣ	ΜΒ	Rome	42
ΙΤΑΛΙΑΣ	ΜΒ	Italy	42
ΔΑΛΜΑΤΙΑΣ	ΜΒ	Dalmatia	42
ΓΑΛΛΙΑΣ	ΜΒ	Gallia	42
ΚΑΠΠΑΔΟΚΙΑ	ΜΓ	Cappadocia	43
Κ[...]ΝΣΤΑΝΤΙ	ΜΓ	Constantinople	43
[.]ΡΜΕΝΙΑΣ	ΜΔ	Armenia	44
Π[...]ΝΝΟΝΙΑΣ	[.]Δ	Pannonia	44?
[...]ΘΥΝΙΑΣ	ΜΔ	Bithynia	44
ΓΕΡΜΑΝΙΑΣ	Ν[.?]	Germania	50[+?]

15 British Museum, London

ΜΕΡΩΗΣ	ΙΣ	Meroe	16
ΣΟΗΝΗΣ	ΚΔ	Syene	24
ΘΗΒΑΤΔ	ΚΔ	Thebais	24
ΛΙΒΥΗΣ	ΚΔ	Libya	24
ΑΙΓΥΠΤΟΥ	ΛΑ	Egypt	31
ΑΛΕΞΑΝΔ	ΛΑ	Alexandria	31
ΠΑΛΑΙΣΤ	ΛΒ	Palestine	32
ΠΕΝΤΑΠ	ΛΒ	Pentapolis/-eis	32
ΑΦΡΙΚΗ	ΛΔ	Africa	34
ΚΡΗΤΗΣ	ΛΔ	Crete	34
ΚΥΠΡΟΥ	ΛΕ	Cyprus	35
ΚΟΥΛΗΣ	Λς	Coele (Syria)	36
ΣΙΚΕΛ[.]Α	Λς	Sicily	36
ΠΑΜΦΥΛ	Λς	Pamphylia	36
ΑΧΑΪΑΣ	ΛΖ	Achaia	37

(Continued)

Table 4.1 (Continued)

15 British Museum, London			
ΤΑΡΧΟΥ	ΛΖ	Tarsus	37
ΣΠΑΝΙΑ	ΛΗ	Spain	38
ΑΝΤΙΟΧ	[.]Θ	Antioch	[3]9
ΠΕΛ[.]Π	[.]	Peloponnese	39—41?
ΘΕΣΣΑΛΟ	Μ[.]?	Thessalonica	40—41?
ΡΩΜΗ	ΜΑ	Rome	41
ΘΡΑΚΗ	ΜΑ	Thrace	41
ΒΙΘΥΝΙΑ	ΜΑ	Bithynia	41
ΑΒΥΔΟΣ	ΜΑ	Abydos	41
ΔΑΛΜΑΤ	ΜΒ	Dalmatia	42
ΚΑΠΠΑΔ	ΜΓ	Cappadocia	43
ΙΤΑΛΙΑ	ΜΓ	Italy	43
ΚΩΝΣΤΑ	ΜΓ	Constantinople	43
ΓΑΛΛΙΑ	ΜΓ	Gallia	43
ΑΣΙΑ	ΜΓ	Asia	43
Ν[.]ΟΚΑΙΣ	ΜΔ	Neocaesarea	44
ΑΡΜΕΝ[.]Α	ΜΔ	Armenia	44
ΣΑ[.]Μ[...]	ΜΕ	Sarmatia	45
ΠΑΝΝΟΝΙ	ΜΕ	Pannonia	45
ΜΕΔΙΟΛΑΝ	ΜΣ	Mediolanum	46
ΒΡΕΤΤΑΝ	Ν[.]?	Britannia	50[+?]

of the removal of Galatia, Macedonia, and Mauretania, and the introduction of Abydos, Alexandria, Asia, Crete, Libya, Mediolanum, Neocaesarea, Peloponnese, and Sarmatia (i.e., the replacement of three names removed, and the addition of six more that the different design makes possible). Rather, it is the treatment of the latitude figures for the twenty-four or twenty-five names¹⁷ found in both lists that appears surprisingly critical, not to say pettyfogging, by contrast. In the twelve or thirteen instances¹⁸ where the British Museum compiler departs from the Time Museum's figure, ten or eleven are only a single degree up or down, a level of adjustment that would be of no realistic consequence in instances like 43 for Italy instead of 42, or 45 for Pannonia instead of 44. Only three changes are more substantial, Thebais shifted from latitude 28 to 24, Africa from 32 to 34, and Bithynia from 44 to 41. With Cappadocia left unchanged at 43, however, this last shift has the unfortunate consequence of situating that province well to the *north* of Bithynia, as observed earlier in this section. Evidently the meticulous critic in turn proved fallible, therefore. Even so, the more telling perception is that latitude was the critic's passionate concern.

17. The difference depends on whether Coele (Syria) was the one illegible name in the Time Museum list.

18. The difference depends on the British Museum's figure for Thessalonica; this is impossible to determine, but it must have been either 40 (matching that of Time Museum) or 41.

2. Criteria for the Choice of Names

At this point we ourselves should not become so preoccupied by latitude that we forget the equal or greater importance attached by designers and owners to the choice of names in the lists. On only two sundials do the lists leave the impression that they may have been compiled for no more than general reference without any reflection of an individual's specific requests. These lists, on the Rome and Crêt-Châtelard sundials, in effect amount to a single one, leaving aside sundry slips and muddles that have gone uncorrected. There is no knowing how the same rather curious, relatively brief list came to be used on these two sundials of different size and design. Its reuse may at least be an indicator that such sundials were made in some quantity over time, a possibility noted at the start of this chapter. That the two—or some earlier one of which these are copies—should be considered products of the same workshop is certainly a possibility.

There is the further temptation to speculate that the workshop was at Ancona, a port on Italy's Adriatic coast.¹⁹ At least this prospect can then serve to explain why a list of only sixteen names, spanning in effect the entire Roman world from Babylon and Ethiopia to Britain, should include at most three cities—Babylon, Narbo or Nemausus perhaps, and of all places Ancona, instead of even Rome! Such speculation dates back to the original publication of the Crêt-Châtelard sundial,²⁰ but for all its attraction it is vital to understand that as yet there is no supporting evidence or reference. If the list in the form in which it survives really was the original compilation by a workshop rather than a slipshod copy, then that establishment had little cause to be proud of it because, as noted in the previous section, anyone who actually used it to set the sundial while traveling was liable to be poorly served. Perhaps the list was compiled not so much with travelers in mind, but more as a sample demonstration to youngsters, or to anyone unfamiliar with portable sundials, of the potential that such a list offered when individual purchasers had one drafted according to their own requirements. A merit of the list—we might think—is the efficacious spread of its names across the known world, unlike several of the more personal lists to be discussed below. Although it is the shortest such list, its geographical stretch is in effect the widest.²¹

19. *BAtlas* 42 F1.

20. Durand and de la Noë (1896), 16.

21. Needless to say, the Samos list, the Philippi sundial, and the pillbox discs are all to be set aside in considering this claim. The compiler of the Memphis list might contest it, especially if India there does signify the subcontinent (see further below in this section); but in this list coverage of the West remains slight.

Ancona is again among the few cities chosen for inclusion on one of the Vienna pillbox discs. Here it is paired with the region *Tuscia*, even taking pride of place top center on 3 Reverse; Rome and Neapolis form the pair on the other side of the disc. For all that it is remote, the possibility that this sundial too was manufactured at a workshop in Ancona could be considered. It seems more likely, however, that Ancona occurs here precisely because the city was a well-known Adriatic port, and that as such it makes a suitable representative choice of location to be paired with the region *Tuscia* at broadly speaking the same latitude across the Apennines. On the other side of the disc, the two cities of Rome and Neapolis (modern Naples) in Campania serve correspondingly for central Italy. Such logical pairings, and the five more of them on the eight sides of these discs, create the impression that the compiler of this equivalent of a list (without latitude figures) merely wished to provide guidance for the sundial's use in a number of regions across the Roman empire in the purely impersonal, informative way characteristic of Ptolemy. One of its pairs, however, suggests a rather less logical and more personal perspective, when on 4 Obverse Spain is evidently paired with Campania, rather than with a city in Spain—Tarraco, for example, or Emerita—on the clear pattern of three of this sundial's other pairings: Alexandria/Egypt, Africa/Carthage, Gallia/Burdigala. Moreover, the curious choice of Campania (even though this region is indeed situated at much the same latitude as northern Spain) in effect duplicates that of Neapolis on 3 Reverse. No matter, in this instance logic and coverage were overruled by the personal wish of the designer or owner, who apparently preferred to keep a link with both Neapolis and Campania prominently in mind.

Overall, this same combination of choices can be detected in most of the lists: on the one hand, well-known names that more or less appropriately cover the frame of territory forming the compiler's main focus, though there may also be unexpected omissions, and on the other hand, some locations that might be considered less predictable and thus more personal. A further striking feature to be considered is the clustering of names that are evidently important to the compiler or owner, but nonetheless seem redundant for merely providing geographical information. The selection of the four names on the Philippi sundial—the cities Alexandria, Rhodes, Rome, and Vienne, each reckoned to be approximately 5 degrees of latitude apart—may represent a concise ideal for such provision, but (as already observed in Chapter 3 section 3) it also remains the exception.

We may note first, however, the effort—albeit sometimes minimal, and irrespective of the language used—to recognize the broad span of the Roman empire and even beyond; see Maps 2.1–2.14 above, and G.3 below. Thus all four long Greek lists—Memphis, Aphrodisias, Time Museum, British Museum—range at least from as far south as Syene to as far north as Gaul, and the latter two even further north in fact. The corresponding range of all five Latin lists, as well as of the Vienna pillbox discs, stretches from Egypt or Alexandria as far as

Britain. It is no surprise that, with their limited number of names, the Balkans and Science Museum lists (both Greek) offer lesser spans, but even the former ranges from Babylon and Alexandria to Rome, while the latter ranges from Syene to Rome. Predictably enough, within a chosen frame the coverage of names is liable to be unbalanced; see Maps G.1 and G.2. All six Greek lists just mentioned show greater preoccupation with the East than the West. Of the Latin lists, Vignacourt (twenty-three names) and Mérida (nineteen names) lean to the West and North.²² Mérida's inclusion of just a single name in the East (Alexandria) is all the more significant, therefore. Again, Vignacourt's names in the East may be few, but they nonetheless happen to include the sole occurrence of Judaea. Correspondingly, the (Greek) British Museum list alone includes Mediolanum (modern Milan).

The proportion of cities to provinces or regions in a list is variable, with provinces or regions predominating for the most part, in the Latin lists especially. The (Greek) Memphis list is most exceptional in this respect—surely an avid personal compilation—with the vast majority of its thirty-three legible names being cities, ten or more of them occurring only here among the lists as it happens.²³ About half the twenty-eight names in the Aphrodisias list are cities. At the opposite extreme, the Vignacourt list's twenty-three names could be reckoned to include only one city, Alexandria, if *NARBON* and *LVGDVN* are read as provinces. It is puzzling that not a single Latin list includes Constantinople, and that the Oxford list is the only Latin one in which Rome occurs. It is also to be found on the three pillbox sundials: Aquileia, Kircher Museum, Vienna 3 Obverse. By contrast, Rome occurs in all the Greek lists (except Samos, where it is not to be expected), as does Constantinople too, except in the Balkans list and on the Philippi sundial. As noted in Chapter 2, the inclusion of Rome, but not Constantinople, in the Balkans list (no. 16) leads Christine Hoët-van Cauwenberghe to consider it very probable that this sundial predates the establishment of Constantinople in the 320s. There can be no certainty on the point, however, given the individual character of most of the lists. An assumption (whether warranted or not) that every owner of a sundial inscribed in Latin would be sure to know the latitude of Rome anyway—some perhaps because they lived there—is a possible explanation for the city's omission from lists where we might expect to find it; but again, this remains no more than one possibility.

It might equally be said that to include Rome is superfluous when Italy is already being listed (on all the Latin sundials in fact), but this argument should not be pressed in view of the widespread predilection for including clusters of

22. Compare the concern for the West and North shown by the (Latin) Aquincum Fragment, discussed in the Appendix.

23. At least Adrianople, Aquileia, Argos, Berenice, Bostra, Delphi, Edessa, Gortyn, Neapolis (in Palestine), and Syracuse; possibly also Apamea and Heraclea.

names, not all of which (along with their latitude figures) should strictly speaking be needed by users who have even rudimentary geographical awareness. The inclusion of both Constantinople and Chalcedon—two cities separated only by a narrow strait—on the Samos sundial strikes the modern observer at least as an egregious instance of such redundant listing, even though there may be some justification if a route is being traced, as seems to be the case here. Equally, it must be an engaged individual's choice that three of only twelve names on the Balkans sundial (supposedly found in Bulgaria) are Moesia Superior, Moesia Inferior, and Thrace, while neither Byzantium nor Constantinople is chosen for inclusion here. Again, only personal preference of this type can have prompted the inclusion of all three Spanish provinces—Baetica, Lusitania, Tarraconensis—in the Mérida list. The Vignacourt list, to be sure, does include Callicia as well as Spain. Otherwise, in six other lists where Spain occurs, as well as on the Vienna pillbox 4 Obverse, this single name suffices for the Iberian peninsula. We may note that the Mérida sundial, although found in Spain and perhaps produced there, also reflects wider concerns insofar as it lists four Gallic provinces (Aquitania, Belgica, Lugdunensis, Narbonensis), as does the Vignacourt sundial found in Gaul.

The four long Greek lists—on the Aphrodisias, British Museum, Memphis, and Time Museum sundials—all accommodate four or five names in Egypt and Nubia (including Meroe and Berenice); the city of Memphis is among these names on the sundial found there. The three names in Greece (Argos, Athens, Delphi) on the Memphis sundial could also be considered a redundant cluster for provision of latitude; so, too, this sundial's trio Bostra, Caesarea, and Neapolis, separated by half a degree at most. Among cities, the unique occurrence of Neocaesarea in the British Museum list seems a less predictable, and thus more personal, choice.²⁴ If my conjectures in Chapter 2 above are accepted, the same may be said of Mytilene in the Samos list and of Dor(a) and Ake in the Science Museum list.²⁵

By the same token, for us today at least, some region names at the edge of the Roman empire or beyond are so elusive to identify even with reference to their latitude figure that they too amount to private choices, much like some of the cities with common names discussed in Chapter 3 section 4. "India" in

24. The point should not be taken to imply a further claim that such a choice was in fact an obscure city. Note the reference made to Neocaesarea in *Dig.* 27.1.6.9 by the early-third-century CE jurist Herennius Modestinus (*OCD* s.v.).

25. For similar combinations of predictable and more personal choices by commissioners of mosaics, note striking examples from Ammaedara (Tunisia, late third or early fourth century CE) and from the Church of St Stephen, Umm Al-Rasas (Jordan, 756 CE). For the former, Fathi Bejaoui, "Îles et villes de la Méditerranée sur une mosaïque d'Ammaedara (Haïdra, Tunisie)," *CRAI* (1997): 827–60 at 853, 855, and 858 (observations by Maurice Euzennat); for the latter, Michele Piccirillo, *The Mosaics of Jordan* (1992), 36, 238.

particular was used so loosely in antiquity as the name for several distinct geographical areas—the subcontinent, as well as anywhere far to the east and south of the Roman empire—that it is impossible to be sure quite what its unique occurrence in the Memphis list (with latitude figure 8) is meant to signify.²⁶ The subcontinent remains perhaps the most likely prospect here, and it does in fact extend south to approximately latitude 8 00. The Memphis list—on a sundial found in Egypt, after all, and possibly made for an owner resident there, who preferred the Alexandrian calendar to the Julian—is also the only one to include Berenice, one of Egypt's two main Red Sea ports (with Myos Hormos) from which merchant ships set out for the Indian Ocean.²⁷

Two different perceptions of Sarmatia are evident from its three occurrences. The Mérida and British Museum lists locate it (at latitudes 43.5 and 45 respectively) no further north than their latitude (45) for Pannonia, whereas at latitude 53 in the Vignacourt list it is set decisively beyond the Roman empire, two degrees further north than this list locates Moesia and Dacia.²⁸ Similarly, in the absence of any longitude figure there can be no certainty about just where the designer of the Balkans sundial or the compiler of the British Museum list envisaged Libya—listed at latitude 24, the same latitude as for Syene and Thebais, and thus far into the interior of Africa. Ethiopia in both the Rome and the Crêt-Châtelard lists gives rise to the same uncertainty: lands south of Egypt could be meant, but Ethiopians were also thought to live far into Africa further west.²⁹

Among all the lists, it seems fair to claim, testimony to personal, private preferences can be found most fully on the Oxford sundial. In the first instance, the designer or owner evidently chose to have as few as six names engraved on the reverse (even fewer than the twelve on the Samos sundial), in no obviously logical order, all of them provinces or regions perhaps, and with Gallia hardly even necessary when NARB(onensis) and LVGD(unensis) are both included (see Fig. 2.26). Insertion of further names subsequently represents a creative enhancement, although there is no telling the number of stages by which this was done, let alone whether it was the original designer or owner

26. Note, for example, the general discussions by Grant Parker, *The Making of Roman India* (2008), 247–50; and S. F. Johnson, “Real and Imagined Geography,” 394–413, in Michael Maas (ed.), *The Cambridge Companion to the Age of Attila* (2015), at 409–12.

27. See S. E. Sidebotham, *Berenike and the Ancient Maritime Spice Route* (2011).

28. Note David Braund's cautionary comment on the inevitable difficulty of assigning a specific location to the Sarmatians (*BAtlas Directory*, p. 1202). For Sarmatia envisaged as bordering on the Roman empire, see *Dimensuratio Provinciarum* 8–9 (*GLM*, pp. 10–11), with comment by Salway (2012), 196; this text is also edited with a German translation by Kai Brodersen in the *Sammlung Tusculum C. Plinius Secundus d. Ä., Naturkunde, Buch 6* (1996), 329–66.

29. *OCD*⁴ ss.vv. Libya, Ethiopia (by Joyce Reynolds and Robert Morkot respectively).

who took this initiative in whole or in part.³⁰ There is good reason to regard the sixteen names inserted between ITAL and GER as a coherent set. By contrast, the eight names that fill the remainder of the reverse—the city of Rome, four successive regions or provinces in central or eastern Europe, and three in Asia Minor—lack that cohesion, and they are not arranged in order of latitude. For certain, there is no duplication of any name among the eight and the sixteen. It is at least imaginable that the four and the three, and even Rome itself, each relate to a tour of duty, say, or some venture that the owner undertook to these parts of the Roman empire, in which case the names could have been added piecemeal rather than all together.

The sixteen names—arranged coherently in order of latitude—present an eclectic set of regions. They invite comment in two related respects. First, it seems curious that the choices made for this set did not take into account more closely the six names and figures already engraved on the sundial. To be sure, account evidently *was* taken to avoid the repetition of GER; hence the original GER was supplemented to become GERI. However, ITAL and NARB were not removed from the sixteen, even though both names are among the original six; instead, the decision was that each should appear twice, and with different latitude figures. It is a puzzle that the compiler should be content with this mix of duplication and minimal, indeed needless, adjustment. These choices appear all the odder if we imagine that the main purpose in supplementing the original six names would have been to expand the range of locations at the user's disposal.

Second, it also seems curious that a compiler aware of the potential value of this expansion should be content with so many notably inaccurate latitude figures among the sixteen—those offered for Lycia, Cilicia, Asia, Sicily, Africa, and Mauretania in particular—alongside others that are altogether accurate. In the further cases of the figures for Cappadocia and perhaps Cyrene, the compiler was ill-served by the engraver, but still for the most part it must be the compilation itself that is flawed, and by extension presumably whatever source was consulted for latitudes. Possibly it was the same source that again provided misleading figures for several names among the eight. Thus latitude 35 situates Bithynia too far south (the latitude of Cyprus!), and specifically south of Phrygia, which at 36 is also located far south. Elsewhere latitude 45 situates Galatia as far north as the Crimea, while latitude 52 situates Dacia even further north than the two German provinces, placed accurately at latitudes 49 and 51.

30. Strictly speaking, it cannot be ruled out that some or all of the further names discussed below were the *first* to be engraved here, and that the six were inserted *later* to fill gaps purposely left in order to separate groups of four names. Even so, it is hard to credit such a sequence, and the six choices of names would then seem really strange.

3. The Appeal of the Object

Understandably, the opportunity to compile a private list of names and latitude figures might please an owner, however curious and unsatisfactory the result may appear to us. All the same, this need not have been an owner's main motivation for acquiring the Oxford sundial or one like it. The very ingenuity of the object itself must have exerted a powerful attraction too, and inventive designers clearly competed to gratify owners in this respect. In the seventeenth century, allure of this type is candidly admitted by the diarist Samuel Pepys (1633–1703) with reference to the valuable watch that has just been repaired by his watchmaker:

(May 13, 1665) So home, and late at my office. But Lord, to see how much of my old folly and childishnesse hangs upon me still, that I cannot forbear carrying my watch in my hand in the coach all this afternoon, and seeing what a-clock it is 100 times. And am apt to think with myself: how could I be so long without one—though I remember since, I had one and found it a trouble, and resolved to carry one no more about me while I lived.³¹

Plenty of Greeks and Romans found themselves equally captivated by instruments and gadgets, real or imaginary.³² In the fantasy of one fourth-century Latin author, the possessions of the extravagant, unbalanced second-century emperor Commodus had even included vehicles that measured the distance covered and told the time.³³ Not only do the geographical portable sundials cater to such fascination with technology, but some of the designs for them also plainly indicate an appetite for enhanced ingenuity. Although it is impossible to trace a chronological sequence for such enhancements, or to relate one closely to another, three aims behind them may be broadly identified.

One is a striving for compactness (already noted in section 1 of this chapter), which gains its most extreme expression perhaps in the pillbox sundials—modeled on coins and filled with multiple thin discs—but is also seen in the capacity to transform the Philippi ring sundial into a flat object. A second aim is to facilitate setting the latitude at the user's location. This concern is to be seen no doubt in the design of an obverse comprising an inner and outer pair of discs rather than just a single one, as in the case of the Oxford sundial and,

31. Robert Latham and William Matthews (eds.), *The Diary of Samuel Pepys*, vol. VI, 1665 (2000), 101; cf. the entry for September 13 (p. 221).

32. For an overview, see Örjan Wikander, "Gadgets and Scientific Instruments," in J. P. Oleson (ed.), *The Oxford Handbook of Engineering and Technology in the Classical World* (2008), 785–99.

33. *Historia Augusta*, *Pertinax* 8.7, "[vehicula] iter metientia horasque monstrantia."

evidently, the lost Rome sundial. On obverse rims, numbering the latitude scale with figures at two sets of intervals in one instance (British Museum), and striking a punch mark at latitude 43 in another (Time Museum), must be further modest responses to the same concern.³⁴ With the aid of the punch mark, the user who wants to make the setting for Constantinople or Cappadocia—both listed at this latitude on the reverse of the sundial—can confidently do so without hesitation.

The designer of the Balkans sundial develops this small convenience into a principal feature by completely dispensing with any list on the reverse, and instead inscribing names (in four groups of three) on the obverse; a suspension arm and a bar at right angles are secured to it. To set the sundial for the latitude of any name in two of the four groups, the arm simply has to be rotated so that it forms a vertical underline below that name; for a name in the other two groups, the bar must be below it horizontally. Latitudes are of course taken into account for the design, but no figures appear on the sundial, because the user does not need them in order to make the setting for a location. The limitation imposed by this convenience is that in effect the sundial can be used only in the twelve locations named. No means of setting it for any degree along a range is offered; but then a user who preferred this level of versatility would in any case gladly opt for a sundial that could prove rather more demanding to operate. The pillbox sundials with multiple discs have a similar mix of convenience and limitation; on these discs, too, no latitude figures appear because the user's only options are to select a city or region, and then to slot into place the disc on which it is inscribed.

A third aim of enhanced design is proposed by Denis Savoie and Marc Goutaudier with reference to the Vignacourt and Mérida sundials.³⁵ On the reverse of both, six or seven transverse curved lines are drawn with a Latin abbreviation for a month or solstice at each end; on the Vignacourt sundial, through these lines parts of four equidistant circles are drawn marked at ten-degree intervals for latitudes 30 through 60. The proposal is that this enhancement, with the use of a short horizontal shadow caster, offers anyone who does not know the latitude of his or her location within this range a more convenient means of determining it than is otherwise possible with a portable sundial (Fig. 4.2). Savoie and Goutaudier make a convincing argument in this respect. More questionable, however, is their assumption that—untypically—the obverses of these sundials were always blank, as both appear to be today in their poorly preserved state. If that were the case, then (as Savoie and Goutaudier acknowledge) the functions that could be performed were very limited; in addition, there would seem to be no reason for taking the trouble to inscribe twenty-

34. Compare the Aquincum Fragment discussed in the Appendix.

35. Savoie and Goutaudier, "Les disques de Berteau-court-les-Dames et de Mérida: méridiennes portatives ou indicateurs de latitude?" (2012), 115–19.

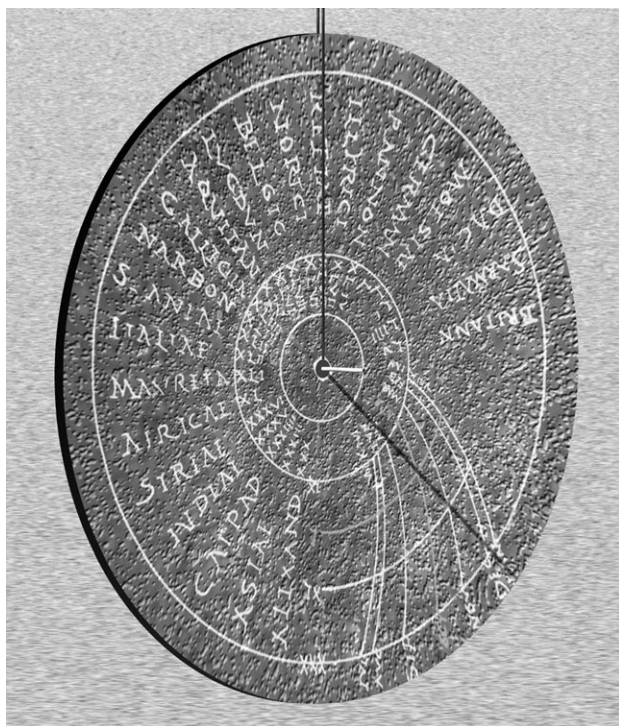


FIGURE 4.2 Vignacourt/Berteaucourt-les-Dames, no. 13: reconstruction of the reverse.

Denis Savoie and Marc Goutaudier in *Revue du Nord* 398 (2012): 115, fig. 1.

three (Vignacourt) or nineteen (Mérida) names and latitude figures on the reverse. When no component of either sundial beyond a single disc survives to inform us further, the possibility should also be considered that both were designed—and originally inscribed on the obverse—not only to tell the time like other such instruments, *but also* to offer a convenient means of determining latitude. Such enhancement of the regular function would be the distinctive feature of these sundials, and their special appeal to owners. The Science Museum sundial, which offers its user two devices in one complex instrument, is a comparable case in this respect. Its inventive versatility comes with consequences, however: the combination of geared calendar and portable sundial inevitably sacrifices compactness, and makes it a relatively deep and weighty object as well as an expensive one to produce.

4. The Spreading of Knowledge and Related Attractions

The question of how the scientific and geographical knowledge to appreciate the functioning of portable sundials was spread demands attention, but only an outline response is possible when so little information survives to provide insight.

To begin on a cautionary note, there is sound reason to maintain that the sciences, including geography, had at best a marginal place in the Roman empire's school curricula except at the highest level.³⁶ It was certainly considered necessary for pupils to gain some awareness of the locations, physical features, and peoples referred to in the canon of literary texts (poetry above all) that they were required to read, but this insight was typically no more than perfunctory and traditional. Geography was not taught for its own sake, let alone with a practical focus on current conditions. The usual teaching tools were lists of names (often for memorization) at the elementary level, and thereafter commentaries on the classic texts prepared by grammarians, as well as encyclopedic catalogs that encapsulated established knowledge with minimal concern for updating it. Maps were produced and circulated, but were evidently not made a primary resource; no standard format for their presentation ever developed. Engagement with literature therefore played a formative role in shaping the geographical grasp shared by those inhabitants of the Roman empire who had attained a reasonable level of education. Relatively few pupils would proceed further to acquire education at the highest level, where they might receive instruction in mathematics and astronomy among the sciences, and tackle such works of scholarship as Strabo's or Ptolemy's *Geography* or Pliny's *Natural History*.³⁷ We are aware that in addition there were also scholars (not necessarily teachers) who studied such works, because some demonstrate as much in their surviving writings.

As argued in Chapter 3 section 3, the latitude figures on the geographical portable sundials can certainly be thought to provide further indirect testimony to the impact of Ptolemy's *Geography*, with its concise means of recording thousands of coordinates. Even so, there was no need for the designer or owner of such a sundial to have read Ptolemy's work, or to derive latitude figures from it rather than (as many in fact did) from other sources unknown to us, including personal observation. Individuals whose enthusiasm was aroused could acquire a basic understanding and more through, for example, the kinds of informal contacts that might easily be cultivated in the environment of the public libraries in Rome, Alexandria, Ephesus, and many other cities throughout the empire.³⁸ A portable sundial, after all, was a conspicuous, shiny metal gadget

36. See, for example, S. F. Johnson, "Travel, Cartography, and Cosmology," 562–96 in id. (ed.), *The Oxford Handbook of Late Antiquity* (2012) at 567–72; id. (2015); Patrick Gautier Dalché, "L'enseignement de la géographie dans l'antiquité tardive," *Klio* 96.1 (2014): 144–82; and, more fully, Félix Racine, "Literary Geography in Late Antiquity" (2009).

37. The likelihood is that neither *Geography* was ever widely known. Note in this connection D. W. Roller (trans.), *The Geography of Strabo* (2014), 27–28. In the Introduction (p. xi) to his edited volume *Ptolemy in Perspective: Use and Criticism of His Work from Antiquity to the Nineteenth Century* (2010), Alexander Jones underlines Ptolemy's own apparent lack of interest in promoting himself or any of his extensive work.

38. For an instance of this atmosphere, note the late-second-century conversation in a library in Rome between Aulus Gellius, fellow scholars, and an unnamed young man (*adulescens*

likely to attract attention and inquiries as soon as it was brought out. Ostentatious owners would relish the opportunity to impart their knowledge and recommend designers. Presumably, the typical educated inquirer would in any case already have some awareness of the thinking behind the design and functioning of fixed sundials, which were so ubiquitous. There is every reason to imagine that the designers and owners of some of the geographical portable sundials must have been learned and passionately engaged, as can be inferred from the dual-purpose Science Museum sundial, for example, or from the many latitude figures stated to one or other fraction of a degree in the Aphrodisias, Memphis, and Samos lists. All the same, high levels of learning and engagement were not essential, and we may suspect that the owner of the Oxford sundial by contrast did not have them, or at least not in equal measure. No doubt snide remarks were passed about the capacity of such less-well-informed owners, in just the way that pretentious book collectors incapable of appreciating the contents of their libraries were repeatedly criticized.³⁹

The lists on the geographical portable sundials offered designers and owners opportunities of a type that many educated Greeks and Romans of the imperial period were eager to embrace. As Jason König and Tim Whitmarsh demonstrate in a compelling overview,⁴⁰ there was widespread enthusiasm at this date not only to assemble knowledge of all kinds and organize it (often in the form of lists), but also to synthesize it and summarize it selectively. Moreover, this relentless quest for such mastery of knowledge becomes closely associated with a shared sense of imperial mission and of Romans' identity as rulers of the world, a boastful claim attested in Latin rhetoric as far back as the early first century BCE.⁴¹ To cite only one outstanding example, this linkage is forged in the strongest possible terms during the late first century CE by Pliny the Elder's encyclopedia, the *Natural History*, when it makes Rome the touchstone to which its entire vast sweep of topics is related.⁴² The wide imperial

quispiam) recorded by Gellius in his *Attic Nights* 13.20; see further Matthew Nicholls, "Libraries and Communication in the Ancient World," in F. S. Naiden and Richard Talbert, *Mercury's Wings: Exploring Modes of Communication in the Ancient World* (forthcoming).

39. Note, for example, the essay entitled *The Ignorant Book-Collector* by the second-century CE Greek satirist Lucian. See further Y. L. Too, *The Idea of the Library in the Ancient World* (2010), 109–10; G. W. Houston, *Inside Roman Libraries: Book Collections and Their Management in Antiquity* (2014), 214–16.

40. König and Whitmarsh (eds.), *Ordering Knowledge in the Roman Empire* (2007), 3–39.

41. Even at that date, phrased in terms of the sun's rising and setting; see *Rhetorica ad Herennium* 4.13 and 44, with discussion by John Richardson, *The Language of Empire: Rome and the Idea of Empire from the Third Century BC to the Second Century AD* (2008), 55–57.

42. See Trevor Murphy, *Pliny the Elder's Natural History: The Empire in the Encyclopedia* (2004). On cultural unity and variation, see in brief, for example, Jaś Elsner and Greg Woolf in Peter Garnsey and Richard Saller, *The Roman Empire: Economy, Society and Culture* (2nd ed., 2015), 222–27.

span encompassing East and West that the sundial lists typically reflect matches the outlook celebrated by an orator in Gaul during the 290s. Having praised the potential value of a world map (now lost) in a school at Augustodunum⁴³ as a teaching tool for visualizing where recent incursions into the empire, and rebellions within it, have been resolutely overcome by the co-emperors, he then exclaims in the climax of the speech, “For now, now at last it is a delight to examine a picture of the world, since we see nothing in it which is not ours.”⁴⁴ The same satisfying sense of possession and control was to be gained from contemplation of the Peutinger Map (introduced in Chapter 3 section 5, with Fig. 3.1). Not least because it survives only in an incomplete medieval copy, much about the date of the original, its overall layout, and its intended context and purpose remains controversial. A plausible case can be made for an early-fourth-century date, however,⁴⁵ together with a concern on the part of its designer to represent Rome as not only ruling a vast empire that stretched from West to East, but also holding sway over the entire known world, in particular as far to the East as India. Needless to add, these were traditional claims, even if this map’s selective representation of them within such an extraordinarily elongated, squat frame was novel. Despite the likely date of its original production, the Peutinger Map’s designer preferred not to reflect the widespread reorganization and renaming of the empire’s provinces instituted around the beginning of the fourth century. Like the lists on the sundials, this map was never intended to furnish a reliable representation of contemporary reality, nor indeed the actual circumstances of any one specific period.⁴⁶

Even though contemporary reality would form one element in the worldview of educated individuals, their mental map otherwise remained a fixed, traditional one gained from the study of literature in school, where grammarian teachers demanded, among other requirements, attention to correct spelling of geographical names along with accurate recall of their significance in literature.⁴⁷ As Félix Racine observes:⁴⁸

Reading classical poetry closely in school and hearing the grammarian’s commentary on place-names mentioned by poets was for the educated Roman the first lens through which he learned to see the

43. *BAAtlas* 18 B3, modern Autun.

44. *Panegyrici Latini* 9(4). 21.3 Mynors, “Nunc enim, nunc demum iuvat orbem spectare depictum, cum in illo nihil videmus alienum.”

45. Even 336 CE is a possibility, as proposed by T. D. Barnes, review of Talbert (2010a), in *Journal of Late Antiquity* 4.2 (2011): 375–78 at 378.

46. On this aspect, note Talbert (2010a), 134.

47. Valuable insights on all these aspects are offered by Racine (2009), 74–76, 89–90, 94–98, and further.

48. *Ibid.*, 79.

wider world, a lens that would be later supplemented but never completely replaced by direct experience, personal contacts and the flow of news.

The lists on the sundials, too, are composites. Some of the names seem more likely to be included for their cultural and historical associations than for their contemporary importance (such as it was) or for any realistic prospect that the owner of the sundial would actually visit these places. Their other associations aside, Meroe, Syene (at the southern border of Egypt), and Rhodes would all have been meaningful to anyone acquainted with the efforts of scientists, from Eratosthenes onward, to measure the earth's circumference and to develop a system for determining and recording locations.⁴⁹ Six lists include Rhodes, five Syene, and three Meroe—all of them Greek lists.⁵⁰ Again, regions at the fringes of the Roman empire or beyond, such as Babylonia, Ethiopia, and India, may be included in the lists, not so much for a practical purpose, but more for their exotic resonance. That said, their inclusion along with other locations far from wherever the owner of the portable sundial might happen to live conveyed the conviction that it would be entirely feasible for the owner to travel there if the wish or need arose.

One blunt indication of Romans' pride in their empire was indeed the sure knowledge that they had instituted the means as well as the freedom to travel anywhere within it by land or by water, not to mention far beyond in several directions.⁵¹ For travel overland at least, confidence of this type is conspicuously highlighted by the Peutinger Map with its red route line work, colorful vignettes for cities, and widely spread bold lettering for the names of many peoples and regions.⁵² Such confidence is reinforced too by the itinerary lists for long-distance land travel, which survive in a variety of formats, and despite their austere character could serve to impress and motivate would-be travelers.⁵³ Take, for example, this typical listing (in Roman miles) for a journey from Lauriacum

49. See Chapter 3 section 2. Note further, for example, Ptolemy *Geog.* 1.23 Stückelberger, where the parallels envisaged through Meroe, Syene, and Rhodes are among those singled out in his instructions for making a world map.

50. The Aquincum Fragment names Syene and Rhodes in Latin (see Appendix).

51. On freedom to travel, see R. J. A. Talbert, "Roads Not Featured: A Roman Failure to Communicate?" 235–54, in S. E. Alcock, John Bodel, and R. J. A. Talbert (eds.), *Highways, Byways, and Road Systems in the Pre-Modern World* (2012b), at 243–46.

52. Visit www.cambridge.org/9780521764803, Map A and Database.

53. For itineraries, see Salway (2012), 204–10; further, R. J. A. Talbert, "Author, Audience and the Roman Empire in the *Antonine Itinerary*," in Rudolf Haensch and Johannes Heinrichs (eds.), *Herrschen und Verwalten: Der Alltag der römischen Administration in der Hohen Kaiserzeit* (2007), 256–70. Like the lists on the sundials, the itineraries for the most part do not refer to names of physical features or peoples.

(*BAtlas* 12 H4) to Veldidena (*BAtlas* 19 D2). At first glance it appears entirely feasible, with no hint that the route chosen is in fact very circuitous⁵⁴:

Ovilavis XXVI
Iaciaco XXXII
Iovavi XXVIII
Bidaio XXXIII
Ponte Aeni XVIII
Isinisco XX
Ambrae XXXII
Ad Pontes Tesseninos XL
Parthano XX
Veldidena XXIII

By definition, a capacity to travel widely and the freedom to do so are natural expectations—or at the very least hopes—on the part of any owner of an adjustable portable sundial. Otherwise, to possess such a versatile instrument lacks point, except perhaps as a focus for some of the frustrations that, say, a person sentenced to exile might feel. Whether owners actually fulfilled their natural hopes and expectations of travel is another question, which need matter little to us. A geographical portable sundial could still be a cherished personal possession, a handy manifestation of plans and dreams. We cannot know whether the owner of the Aphrodisias sundial, for example, ever undertook even part of the ambitious *periegesis* that its list outlines, or whether the owner of the Memphis sundial gained the chance to make an Aegean tour with visits to the historic places there on its list—Rhodes, Gortyn, Argos, Athens, and Delphi. Equally open is the possibility that these two lists, and perhaps some further ones or parts of them (as on the Oxford sundial), instead serve as mementos of travels actually accomplished rather than just projected. The way in which the list on the Oxford sundial can be shown to have grown raises the possibility that this was an instrument that remained in the same family, with the owner in one generation adding names to those commissioned by the owner in a previous generation. Perhaps, therefore, the engraving of all the As in the added names *without* a cross-bar was far from unobservant inconsistency, but rather a coded, private means specifically requested by the owner to distinguish between successive sets of names.

To serve as a memento must also have been a prime function of, for example, the glass flasks depicting Puteoli already noted (several of them found far from Italy),⁵⁵ as well as three enameled bronze vessels (one found in

54. *Antonine Itinerary* 256,4–258,1 Cuntz in Talbert (2010a), 237–38. Note the absence both of differentiation between the places named (size and facilities) and of explanation for the widely varying lengths of the stages.

55. Chapter 1 section 1, with Figures 1.2A and 1.2B.



FIGURE 4.3 “Ilam Pan,” unearthed in the Midlands of England in 2003 (height 4.7 cm, diameter 9.4 cm). An unbroken sequence of letters inlaid with turquoise enamel runs around the top: they form a list naming four forts at the western end of Hadrian’s Wall, followed by words that evidently refer to the Wall itself (at the least *RIGORE VALI* visible top left). Displayed in rotation by the three joint UK owners, the British Museum, London (inv. no. 2005, 1204.1); the Potteries Museum, Stoke-on-Trent; and the Tullie House Museum, Carlisle.

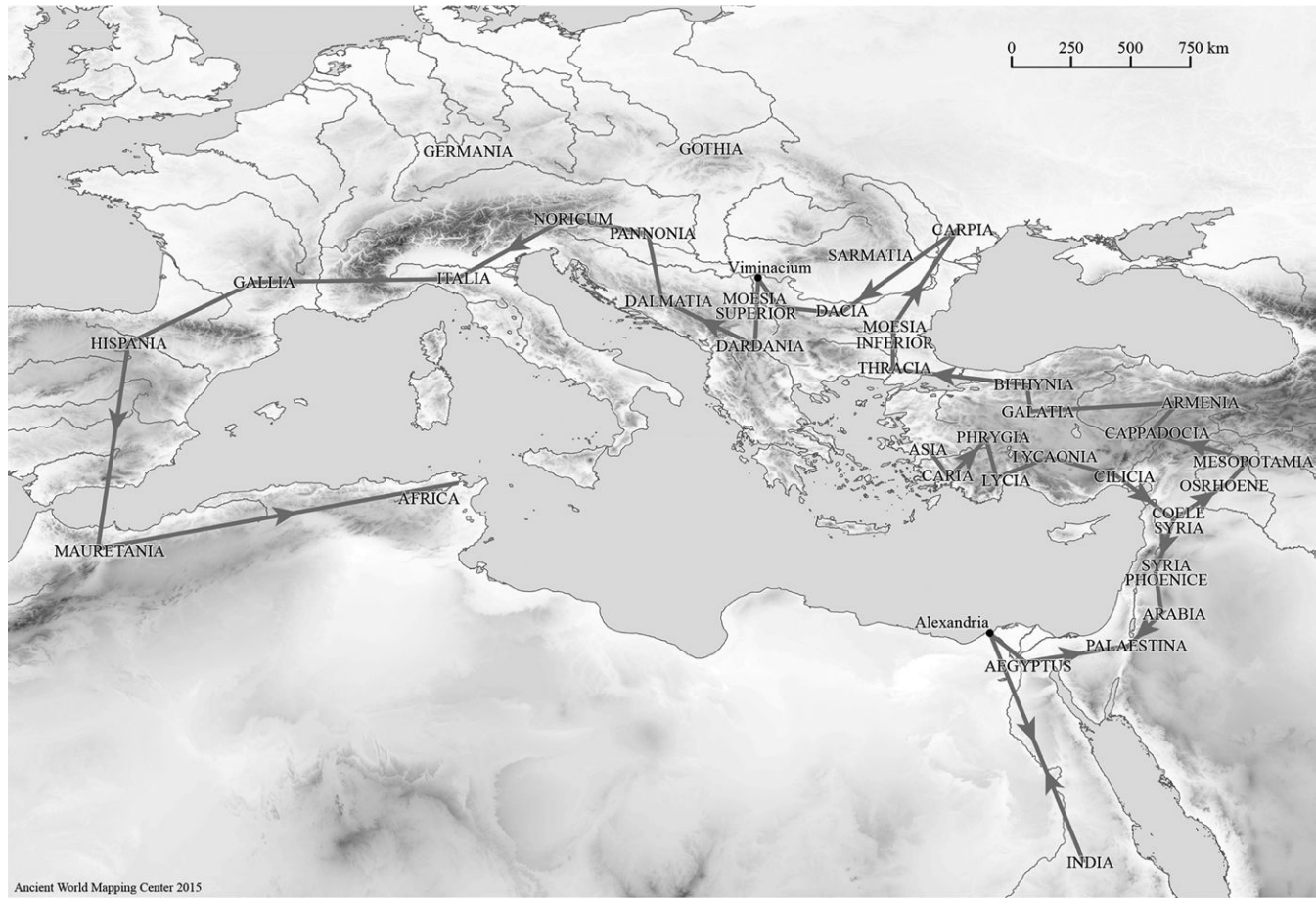
Photo: The Trustees of the British Museum.

northern France) inscribed with the names of forts along Hadrian’s Wall in Britain (Fig. 4.3).⁵⁶ Proud records inscribed to commemorate the travels and achievements of successful soldiers served the same purpose. By far the most rewarding of these in the present context is one in Greek erected by Aurelius Gaius after his return home to Cotiaeum in Phrygia.⁵⁷ Despite the damaged condition of this inscription, analysis of related testimony for the period makes it possible to determine that he served successively among forces led by the Tetrarchs Galerius, Diocletian, and Maximian between 294 and 298. Not only does he boast specifically that he had made a circuit of the empire, but he also—as argued for the first time by Kevin Wilkinson—intends his list of locations to be read as an itinerary or tour (*periegesis*):

... (sc. I) circled the empire to Asia, Caria, [Phrygia?], Lycia(?),
 Lycaonia, Cilicia, [Coele Syria?], Syria Phoenice, Arabia, Palaestina,
 [Aegyptus], Alexandria, India, [Osrhoene?], Mesopotamia,
 Cappadocia, [Armenia?], Galatia, Bithynia, Thracia, Moesia

56. See D. J. Breeze (ed.), *The First Souvenirs: Enamelled Vessels from Hadrian’s Wall* (2012), 1–4.

57. *BAAtlas* 62 C3.



MAP 4.2 Aurelius Gaius' circuit of the Roman empire.

Ancient World Mapping Center.

[Inferior?], Carpia, [Dacia, Moesia Superior?], Sarmatia four times, Viminacium [----] Gothia twice, Germania [----] Dardania, Dalmatia, Pannonia, [Noricum, Italia?], Gallia, Hispania, Mauretania, [Africa].⁵⁸

As Map 4.2 illustrates, Aurelius Gaius includes Sarmatia, Gothia, and Germania at appropriate stages in his record, although he does not consider them integral to the circuit he has in mind. Rather, having spent most of his military career in the Danube lands, he had traveled to at least two of these regions (and probably all three) more than once. His record is certainly comparable to the list on the Aphrodisias sundial, as discussed above in Chapter 3 section 6 with Map 3.3. Moreover, like the compilers of the lists on the sundials, Aurelius Gaius does not use the names of peoples, or any of the new names for provinces that the Tetrarchs' reorganization brought with it.⁵⁹ Almost all his names are regions or provinces (with only two cities), including "exotic" India.

5. Time-Telling Needs

Regardless of other possible aims, in principle the overriding purpose of the geographical portable sundials is to enable their owners to monitor time in the course of extensive travels. To determine just what need owners had to do this, however, is a less straightforward matter. On the one hand, in antiquity the functioning of almost all society's activities was clearly not regulated by the close attention to time that has become the norm in the modern era.⁶⁰ Among much else, mass-produced precision instruments for the purpose did not exist. Nor were there commonly agreed and understood divisions of time. On the other hand, throughout the Roman empire many more or less well-to-do, educated individuals did travel far and wide, and many too were undoubtedly in the habit of pacing their principal daytime activities—such as main meals, law-court sessions, visits to the baths—with some reference to the passing hours. Artemidorus, the second-century CE interpreter of dreams, reflects this outlook

58. My translation incorporates restorations proposed by K. W. Wilkinson, "Aurelius Gaius (AE 1981.777) and Imperial Journeys, 293–299," *ZPE* 183 (2012): 53–58 (without map). For another soldier's record, compare AE 1956.124, translated by Brian Campbell, *The Roman Army, 31 BC—AD 337: A Sourcebook* (1994), 64–65; for a civilian's record, note AE 1975.815.

59. "Il est plus remarquable de noter qu'en dépit des variations des désignations officielles, l'usage populaire reste étonnamment stable. Aucun des noms nouveaux créés pour désigner des provinces nouvelles n'est entré dans l'usage courant," observes Maurice Sartre, "Les voyages d'Aurelius Gaius, soldat de Dioclétien, et la nomenclature provinciale," *Epigraphica Anatolica* 2 (1983): 25–32 at 31.

60. On this uneven and by no means smooth development, see, for example, Gerhard Dohrn-van Rossum, *History of the Hour: Clocks and Modern Temporal Values* (1996); Ogle, *The Global Transformation of Time 1870–1950* (2015).

in declaring, “The sundial symbolizes deeds and actions and movements and the undertaking of business. For men do everything with an eye to the hours.”⁶¹

Such close attention is notable, for example, in the detailed arrangements for an annual cash distribution to be made from a fund to those members of a priesthood at Ostia (*Seviri Augustales*) who were present—quite specifically—at the second hour on the donor’s birthday.⁶² At Puteoli a city ordinance required the public undertaker to remove the body within an hour whenever a suicide was reported. After any slave’s death, the body had to be removed the same day, although if the report was made only at the tenth hour or later, a delay until the first hour of the following day was permitted.⁶³ According to the biographer Suetonius, Rome’s first emperor Augustus even noted on his letters the hour of the day or night at which they were composed.⁶⁴ Examples of that practice can be found in some administrative communications in Roman Egypt; again in Egypt, there is evidence from both the Ptolemaic and Roman periods that the hour at which letters were delivered by couriers was recorded.⁶⁵ In a critical vein, Seneca in the mid-first century CE deplores the feebleness of men

who have themselves conveyed this way and that by sedan-chair and litter, and punctually observe the hours for their rides as if it would be criminal to miss them, who have someone else to remind them when to bathe, when to swim, when to have dinner; they are so enervated by the extreme lethargy of a fastidious temperament as to be incapable of determining for themselves whether they are hungry.⁶⁶

Figures of this type caricatured by Seneca had long been the butt of frustration that we find vented on the Roman comic stage from around 200 BCE by a stock character, the ever-hungry “parasite” or sponger: he is eager for dinner at his patron’s table, but nonetheless constrained to wait because no meal would be

61. *Oneirocritica* 3.66: ὥρολόγιον πράξεις καὶ ὀρμὰς καὶ κινήσεις καὶ ἐπιβολὰς <τῶν> χρειῶν σημαίνει· πάντα γὰρ πρὸς τὰς ὥρας ἀποβλέποντες οἱ ἄνθρωποι πράσσουσιν. Compare Martial, *Epigrammata* 4.8 for the day outlined hour by hour.

62. *CIL* XIV.367 = *ILS* 6164 (182 CE); *CIL* XIV.431 (230s CE).

63. *AE* 1971.88 col. 2 lines 22–23.

64. *Augustus* 50: “Ad epistolas omnis horarum quoque momenta nec diei modo sed et noctis, quibus datae significarentur, addebat.” Such a claim by Suetonius (*PIR*: S 959) carries authority, because he had firsthand knowledge of much correspondence by Augustus.

65. See Sofie Remijnsen, “The Postal Service and the Hour as a Unit of Time in Antiquity,” *Historia* 56.2 (2007): 127–40, especially 138.

66. *On the Shortness of Life* 12.6: “... qui sella se et lectica huc et illuc ferunt et ad gestationum suarum, quasi deserere illas non liceat, horas occurrunt, quos quando lavari debeant, quando natare, quando cenare, alius admonet; usque eo nimio delicati animi languore solvuntur, ut per se scire non possint, an esuriant.”

served until a sundial showed the hour that the patron had prescribed.⁶⁷ The joke must in fact originate earlier in Greek comedy.⁶⁸ In a fanciful digression on the character of Persian society the fourth-century historian Ammianus Marcellinus makes a jibe of the joke: “Among them, only at the king’s court is there a fixed dinner-hour; otherwise each person’s stomach serves as a sundial, and at its prompting they eat whatever is available.”⁶⁹

Those in the habit of often glancing at fixed sundials in their home environment would naturally value the chance to take a portable one with them on their travels. A rich variety of involvements—administrative, agricultural, artistic, commercial, intellectual, medical, military, religious, and more—that may have prompted individuals to travel comes to mind. Ammianus mocks Rome’s senatorial aristocrats for bragging about the productivity of their multiple estates, which stretch (they claim) from the rising sun to its setting.⁷⁰ More soberly, Ammianus (27.11.1) describes his contemporary Petronius Probus—a Roman aristocrat who held as many as four Praetorian prefectures—as the owner of estates scattered across almost the entire Roman world.⁷¹ In the early fifth century the property of another such aristocrat, Melania the Younger, is said to have included estates (to several of which she traveled) in Spain, Campania, and elsewhere in Italy, Sicily, Africa, Mauretania, and Britain.⁷²

Less readily identified are occupations or activities where there might be pressing need to keep a strict watch on the time. The practice of medicine, already cited with reference to the Este cylinder sundial, is one. Land survey may be another, at least to judge by the likelihood that the Time Museum sundial was found with four technical instruments used by a land surveyor (Fig. 2.35). In the opinion of several experts, the sundial could enable a land surveyor to establish a north-south line, although Michael Lewis flatly disagrees.⁷³ It would in any case seem that the primary purpose intended by the sundial’s designer was quite different; so the surveyor may have carried a portable sundial only to

67. Note especially the lines from Plautus’ lost comedy *Boeotia* quoted by Aulus Gellius, *Attic Nights* 3.3.5; see Hannah (2009), 82, for translation.

68. For an overview of attention to hours, see Hannah (2009), 134–39; for discussion of the stage joke, see A. S. Gratwick, “Sundials, Parasites, and Girls from Boeotia,” *Classical Quarterly* 29.2 (1979): 308–23.

69. 23.6.77: “Nec apud eos extra regales mensas hora est praestituta prandendi, sed venter uni cuique velut solarium est, eoque monente quod inciderit editur.”

70. 14.6.10: “... quae a primo ad ultimum solem se abunde iactitant possidere.”

71. *PLRE* I, s.v. Sex. Claudius Petronius Probus 5.

72. *PLRE* I, s.v. Melania 2 (the younger) with references there.

73. M. J. T. Lewis, *Surveying Instruments of Greece and Rome* (2001), 228 n. 22, and references cited there. Note also Oswald Dilke’s discussion of the equipment—including a portable ivory “box” sundial (Winter 2013, 496 [Pompeii, no. 28])—found in the workshop of the land surveyor Verus at Pompeii in *The Roman Land Surveyors: An Introduction to the Agrimensores* (1971), 69–73.

tell the time, like other owners of such instruments. However, there is also the possibility that his collection of instruments tangibly reflects an elevated estimation of his profession's activities, such as Hyginus Gromaticus articulates around 100 CE. His *Constitutio Limitum* (*Establishment of Boundaries*) demonstrates consciousness not only of surveyors' practical role, but also of the global, cosmic, and aesthetic dimensions of their work in principle.⁷⁴

Some devoted Christians might conceivably value a portable sundial to regulate their daily worship, although of the various schedules for prayer recommended by early Christian writers—morning and evening, for example, or simply at three unspecified times—only the most elaborate would really merit the aid of a sundial. This schedule called for morning and evening prayer, as well as at the third, sixth (noon), and ninth hours, and during the night.⁷⁵ Eventually, with the growth of monasteries, strict regulation of monks' time did follow,⁷⁶ although by their very nature these were settled institutions without a particular need for portable sundials. Christian missionaries and pilgrims might be drawn to use them, but no obvious connection to Christianity emerges from the geographical portable sundials; notably, Jerusalem is never among the names chosen.

Recent work on Latin funerary inscriptions by Simeon Ehrlich has documented more than eight hundred instances where either the length of the deceased's life in years, months, days, and hours is recorded, or the day of the month and the hour at which death occurred.⁷⁷ This is an astonishing total, given the low survival rate of inscriptions to be expected. These epitaphs were erected throughout much of the western empire—where Latin was the predominant language of the literate—from the first through sixth centuries CE, with concentrations in and around Rome as well as in North Africa.⁷⁸ In all likelihood many of the individuals who made such a precise record would value having a portable sundial unfailingly at their disposal wherever they might happen to be. Among them there were evidently counterparts to the designers or owners noted in section 1 of this chapter, who obsessed over fractions of a

74. See discussion by Courtney Roby, "Experiencing Geometry in Roman Surveyors' Texts," *Nuncius* 29 (2014): 9–52 at 17–22.

75. See briefly Geoffrey Wainwright and K. B. Westerfield Tucker (eds.), *The Oxford History of Christian Worship* (2006), 60–61 (by Maxwell Johnson).

76. See, for example, Jacques Biarne, "Le temps du moine d'après les premières règles monastiques d'Occident (IV–VIe siècles)," in *Le temps chrétien de la fin de l'antiquité au Moyen Âge, IIIe–XIIIe siècles* (1984), 99–128; Bonnin (2015), 222–23. For fixed sundials at monasteries and other Christian locations, note A. J. Turner, "A Use for the Sun in the Early Middle Ages: The Sun-dial as Symbol and Instrument," *Micrologus* 12 (2004): 27–42 at 30–33.

77. S. D. Ehrlich, "Horae in Roman Funerary Inscriptions" (2012), 14–15.

78. *Ibid.*, 18–23. He explains (8) that he limited his scope to Latin inscriptions and made no more than a preliminary search for comparable epitaphs in Greek; these appear to be far rarer, however.

degree of latitude. So, too, in these epitaphs instances where a half-hour is added to the number of hours can readily be found, and occasionally even shorter measures of time.⁷⁹

In the all-too-frequent instances where the tragedy of a young child's death is being commemorated, it is certainly credible that the recording of hours reflects a preoccupation with the length of human life. Even so, Ehrlich may still be right in imagining a concern with astrology in many instances or, strictly speaking, genethliology, the science of births and casting horoscopes. It was reckoned that the configuration of the heavens at the time and place of birth could predict a person's character and fortunes.⁸⁰ Those who recorded the hour of death believed that the deceased was then about to be reborn into an afterlife in the Underworld. Knowledge of this hour would make it possible to determine the prospects to be expected there, above all which divinity would become the deceased's guardian. Hours even continued to be specified in the same way on some Christian epitaphs, either merely because their inclusion was regarded as standard practice for such records, or perhaps because those responsible believed that awareness of this point could in turn assist prediction of how the deceased would fare in the Christian afterlife under the protection of one or another of the Apostles.⁸¹ Needless to add, although Christian and non-Christian authorities alike generally disapproved of astrology, preoccupation with it persisted at every level of society nonetheless.

6. Conclusion: A Community of Dialers?

Although the very idea is purely imaginative and not to be pressed, for purposes of synthesis it may help to posit the existence of a loose community or fellowship throughout the Roman empire engaged by portable sundials, especially geographical ones. At varying levels, the members of the community all tapped a shared store of knowledge on which the functioning of their instruments depended. This knowledge would typically have to be acquired one way or another outside the regular school curriculum. In particular, every member needed to have some grasp *both* of the thinking behind measurement of time by means of a sundial *and* of the concept of latitude. The capacity to *think* "latitudinally"—to make latitude the basis for visualizing and organizing space—was important, if not vital. Also advantageous, although strictly speaking not essential, was a shared preference for use of the Julian calendar. This is in fact the choice in the design of all the geographical portable sundials—regardless

79. Ibid., 48. Note also the length of a marriage being recorded to the hour in Latin epitaphs (14).

80. For an accessible account, see Roger Beck, *A Brief History of Ancient Astrology* (2007).

81. Ehrlich (2012), 96–97, and his chapter 3 generally.

of whether Greek or Latin is the language employed—except the Greek Memphis one, which employs the broadly similar Alexandrian calendar. As we have seen, two further such shared preferences consistently evident are the listing of only names of cities or regions or Roman provinces, and the association with each of just a single latitude figure expressed in the concise form that seems to be an innovation by Ptolemy in his *Geography*.

Sundials of this distinctive type presumably do not predate the *Geography*'s appearance in the mid-second century CE, therefore. They definitely continue to be produced into the fourth century after the establishment of Constantinople, because its name is listed on all but one of the Greek sundials. There is no knowing how much later their production continued, although perhaps not beyond the fifth century. By this date, with the loss of the West, the strong sense of a Roman world spanning both East and West apparent from almost all the lists was liable to become less and less meaningful. That said, the unshakable preference is for listing Roman provinces nostalgically by names that in effect ignore the major organizational changes instituted from the early fourth century onward. This habit acts to eliminate contemporary reference, and thereby compounds the difficulty of estimating production dates.

A review of the lists of names and figures demonstrates that lists might be copied and recopied as well as adapted, even in a critical fashion apparently, as comparison of the Time Museum and British Museum lists can now suggest. Although the scope, character, and purpose that the compiler of a list had in mind were usually a matter of personal choices of no special significance to others, it is unmistakable that together the lists patently project shared Roman identity, knowledge, confidence, and imperial pride. In these respects and in their relatively uniform format the lists remain consistent, even as some makers of the objects appeal to clients' appetite for gadgets by competing to devise ingenious and more versatile designs.

There is no basis for gauging the quantities in which these sundials generally were produced. At least it would seem a reasonable inference that they were not rarities. At the same time, one stimulus that the enthusiasm shown for them evidently failed to deliver was any marked growth in the use of maps as a means of comprehending the world—not that such a cognitive development is a realistic expectation. Insofar as it is possible to judge by the lists of names and no more than latitude figures, the worldviews to be inferred from these compilations vary considerably in their accuracy, in part perhaps simply because their scope is so ambitious. Continued use of so many variant figures confirms that not even a commonly agreed set of latitudes evolved. Our modern impulse would surely be to recommend that the compiler of the Oxford list, for example, check its figures against a map before the engraver began work. Yet the compiler evidently made no such check, and in any case one might still have left inaccuracies unidentified, because a mapmaker in turn could not be relied on to work from wholly accurate data.

With what frequency the owners of the sundials actually took them on long-distance journeys, and whether they then found them to be a “principal aid” when put to use, as Oswald Dilke so optimistically expected, are further questions about which it is possible only to speculate. Naturally, the sundials may have been used on journeys as well as kept thereafter as mementos, but there is equally the possibility that some were valued more just as prestige-objects, charming miniature display pieces and talking points for more-or-less learned owners at home. In nineteenth-century Europe, growing awareness of the “advantage, privilege and status of owning one’s own timepiece” boosted the sales of watches immensely, even though the more affordable ones tended to be inaccurate and unreliable. The reaction of many buyers was then to strive to make a purchase of better quality.⁸² There is no knowing whether Romans who first acquired a less skillfully designed portable sundial in due course resolved to acquire one of better quality, but such a development is conceivable.

Finally, even though the historical and archaeological record cannot yet identify a single owner of a geographical portable sundial, Latin fiction offers us a colorful figure who bears all the marks of a likely owner of one (or several), had he been created a century or more later: Trimalchio, the former slave from Asia ridiculed in one episode of an adventure novel as a fabulously wealthy Roman freedman and ostentatious dinner host at his home in Campania.⁸³ Despite a glaring lack of education and polish, Trimalchio strives to project himself as a figure of *gravitas*, who collects books in Greek and Latin, and is eager to encourage and contribute to learned conversation about *philologia* despite making some dreadful gaffes. By choosing to adopt the name Maecenatianus, he compares himself to the great Maecenas, who served Rome’s first emperor Augustus as patron of culture. Gadgets please Trimalchio: his dining room, for example, has some kind of retractable ceiling. Even if he might have found it a challenge to think latitudinally, he would doubtless have been captivated by an exquisitely small geographical portable sundial—commissioned in gleaming silver surely, rather than mere bronze—which could be displayed in his cabinet for special treasures and elaborated on with brio. Locations of personal interest to list on it would readily occur to him. For a period, he had invested heavily in long-distance shipping. In Italy he owns some vast Campanian estates that he would like to extend to Apulia, as well as others at Tarracina and Tarentum. To purchase the island of Sicily strikes him as advantageous, because then whenever he might take a fancy to sail to Africa the voyage would all be within his own property. The description of the dinner is full of cosmopolitan

82. D. S. Landes, *Revolution in Time: Clocks and the Making of the Modern World* (2000), 300 (quoted), 306; cf. Ogle (2015), 72–73.

83. Chapters 26–78 of the *Satyricon* by Petronius, written in the mid-first century CE. See in brief *OCD*, s.v. Petronius (1) (by Stephen Harrison), and further Henrik Mouritsen, *The Freedman in the Roman World* (2011), especially 115 and 291.

touches: slave servers supposedly Alexandrian, Egyptian, and Ethiopian by origin, dates from the Thebais region of Egypt, precious cups of Corinthian bronze, bees from Athens, hounds from Laconia, mushroom spores from India, and a tale told by Trimalchio himself involving a Cappadocian.

In addition, this larger-than-life figure is very conscious of time. He has one *horologium* indoors in his dining room (so presumably some kind of water device rather than a sundial),⁸⁴ and he also stations a trumpeter in livery there to give him frequent reminders of what further period of his life has elapsed.⁸⁵ He gives instructions that another *horologium* should occupy the central position on his tomb—not least, he admits, so that anyone checking the hour will then hardly be able to miss reading his name on the monument.⁸⁶ According to his Greek astrologer, he has thirty years, four months, and two days left to live. Last and most important, quite apart from choosing the name Maecenatianus, he is intensely proud of the one Roman office he is permitted to hold, that of *sevir Augustalis*, a priest of the imperial cult. The inability to undertake higher official responsibilities, from which only his slave birth debars him, is a source of deep frustration. Trimalchio fully identifies with Roman values and the Roman empire, therefore. A geographical portable sundial would delight him. Even better, if he put it to use, a unforgettable performance would ensue, with bossing and cuffing of slave assistants, a parade of jumbled knowledge, and even protests addressed to clouds, breezes, and the sun about lack of cooperation on their part. Guests and bystanders could be variously impressed and astounded by such devotion to learning and such exercise of authority. To term Trimalchio a potentially typical owner of a geographical portable sundial would be extreme, but we need not doubt that there were some recognizably similar individuals among the unique community that valued these unlikely and revealing symbols of Greco-Roman culture and empire.

84. Note Winter (2013), 220.

85. Suspicion that some kind of clever device is meant, rather than a human trumpeter, may be justified; see Bonnin (2015), 217–18.

86. Sundials and death are not commonly associated in classical literature; see Jérôme Bonnin, “*Horologia et memento mori*... Les hommes, la mort et le temps dans l’Antiquité gréco-romaine,” *Latomus* 72 (2013): 468–91; id., (2015), 330–31.

5

Post-classical Comparisons

It would surely be premature to conclude this study without giving even brief attention to the large question that naturally occurs to the historian looking forward, namely, What influence, if any, did the types of geographical portable sundials we have been investigating exert on the character of timekeeping devices produced *after* the breakup of the Roman empire and the loss of the West in the fifth century? Predictably enough, the patchiness of the record for the following millennium at least together with the persistently pitiful survival rate of material objects conspire to render a decisive answer elusive. In addition, a history of sundials, which might at once provide a fuller context within which to tackle the question, is still lacking. It is true that Anthony Turner (quoted above in the Preface), while keenly aware of how much remains obscure, planned to attempt such a history in the projected Time Museum catalog volume I.2 *Time-measuring Instruments: Sun-dials and Nocturnals*.¹ Unfortunately, however, this volume was abandoned following reduction of support for the Museum by its founder and the gradual dispersal of his remarkable collection.² No comparable project has yet achieved publication.

At least it is established that the cylinder or pillar sundial now attested in Italy during the first century CE (Chapter 1 section 3) was an

1. See Turner, "Sun-dials: History and Classification" (1989): 303–18 at 303 with notes 29 (not flagged in the text) and 36.

2. The industrialist and financier Seth Atwood (1917–2010) of Rockford, Illinois, established the museum there in 1971, where it remained open until 1999. However, from 1985 he reduced his formerly lavish level of support, and the collection was sold by Sotheby's in six auctions held between 1986 and 2004; only four of the twenty or so projected catalog volumes achieved publication. See William Andrewes (one-time curator) in *Masterpieces from the Time Museum part 4 volume II Chronometers and Scientific Instruments*, New York, Oct. 13 & 14, 2004, unnumbered pages 12–13.

ancient type that somehow remained known,³ and can be shown to have attracted distinctly greater interest and use in western Europe from the eleventh century onward.⁴ It was referred to as the “chilinder” or “traveler’s” sundial, and its manufacture—in wood or metal—formed the subject of numerous treatises. Such a sundial features in two paintings by Hans Holbein the Younger, *The Ambassadors* (1533) and his portrait of the astronomer and craftsman Nicholas Kratzer (1528).⁵ Manufacture of this type continued into the nineteenth century.⁶ Romantics and tourists have long been charmed by the tale that these sundials were used especially, and even made, by shepherds in the Pyrenees; but the tale remains dubious, evidently an early-nineteenth-century fantasy. Be that as it may, it lives on regardless,⁷ despite its lack of foundation trenchantly stressed by Louis Le Bondidier (1878–1945, founder of the Musée pyrénéen de Lourdes) with the support of Edouard Baillaud, director of the Paris Observatory⁸:

This “shepherd’s watch” is never found in the hands of a shepherd, and if presented with one his reaction would be complete astonishment: he would be ignorant not only of how it works, but also of the purpose and use of such an object. . . . The “shepherd’s watch” is no more of peasant origin, and no more a part of genuine Pyrenean folklore, than the shepherd’s songs of the bourgeois Despourrins.⁹

3. Note in this connection Mario Arnaldi, “An Ancient Rule for Making Portable Altitude Sundials from an ‘Unedited’ Medieval Text of the Tenth Century,” *Journal for the History of Astronomy* 42.2 (2011): 141–60; and for comparison id., *De Cursu Solis: Medieval Azimuthal Sundials, from the Primitive Idea to the First Structured Prototype* (2012).

4. See Claudia Kren, “The Traveler’s Dial in the Late Middle Ages: The Chilinder,” *Technology and Culture* 18.3 (1977): 419–35; and the overview offered by Mario Arnaldi et al., *Tempus et Regula: Orologi Solari Medievali Italiani; Le Origini, La Storia*, vol. 1 (2010), 222–25.

5. See, for example, Hester Higton, *Sundials at Greenwich: A Catalogue of the Sundials, Nocturnals and Horary Quadrants in the National Maritime Museum, Greenwich* (2002), 46–48 (by Richard Dunn).

6. For examples from the sixteenth, eighteenth, and nineteenth centuries, see *ibid.*, 235–37, and A. J. Turner, *Catalogue of Sun-dials, Nocturnals and Related Instruments* (2007), 23, 62–65.

7. See, for instance, D. J. Bryden, *The Whipple Museum of the History of Science, Catalogue 6 Sundials and Related Instruments* (1988), Part 4 Section 1 introductory note (pages not numbered). Visit www.nathalie-javaloyes.weonea.com, for example, and the presentation at Les Forges de Pyrène museum, Foix (Ariège, France).

8. *Voyage dans les Pyrénées* (1954), n. 6 pp. 160–61, his rare, posthumously published translation of Friedrich Parrot, *Reise in den Pyrenäen* (1823): “On ne trouve jamais cette ‘montre de berger’ entre les mains d’un berger et si on lui en présente, il marque de l’étonnement, ignorant non seulement la manière d’en servir, mais le but et l’utilisation d’un tel objet. . . . La ‘montre de berger’ n’est pas plus d’origine paysanne et n’appartient pas plus au véritable folklore pyrénéen que les chansons de berger du bourgeois Despourrins.”

9. See further Paul Claracq, “Montres solaires ‘de berger’ dans les Pyrénées,” *Bulletin de la Société Ramond* [Bagnères-de-Bigorre] 133 (1998): 71–112; Denis Savoie, “Les cadrans solaires de hauteur,” *Dossiers d’Archéologie* 354 (2012): 48–51.

When all this is said, the cylinder type—designed for use within no more than a single latitude—can only be classed alongside the Roman geographical portable sundials, not among them. The influence of these sundials is far less evident, and may well even be nonexistent. A later portable sundial of their type has yet to be found, and any influence through publication of finds is hardly to be expected. As we have seen, a Roman geographical portable sundial was made known for the first time only through a publication (and a relatively obscure one) in the mid-eighteenth century; no more were then published until the late nineteenth century, when production of sundials had effectively ceased.¹⁰ However, the Roman makers' inclusion of geographical data on their adjustable portable sundials is a desirable aid to the user, which recurs repeatedly in the designs of comparable instruments by their postclassical successors, and for good reason. Indeed the very fact of this feature being taken so much for granted can no doubt help to explain why such data on Roman geographical portable sundials has been all but ignored. The concise overview of this feature that follows is instructive, therefore, even though it must be frankly acknowledged that there is as yet no basis for claiming any inspiration for it from Roman practice.

1. The Astrolabe

After antiquity, inclusion of geographical data is found first in the astrolabe, a circular instrument comparable to the Romans' adjustable portable sundial although more elaborate, but not necessarily larger.¹¹ There is little doubt that the astrolabe was a Greek invention, made by the fourth century CE at the latest (when we know it to have been the subject of a treatise), although possibly not as early as Ptolemy's time in the mid-second century, despite a predilection on the part of Arabic authors later for attributing it to him.¹² As noted in Chapter 2, the stereographic projection that astrolabes require is found—seemingly as just a decorative feature—on the Vienna pillbox sundial (no. 5), which could date to anywhere between the mid-second century and the fourth century. More generally, it is impossible to say whether geographical portable sundials predate the earliest (now lost) Greek astrolabes, or vice versa. In the present state of our knowledge, the relationship between the two is beyond recovery.

10. For this decline, see Turner (1989), 308–9, 314.

11. D. A. King, *In Synchrony with the Heavens: Studies in Astronomical Timekeeping and Instrumentation in Medieval Islamic Civilization*, vol. 2: *Instruments of Mass Calculation* (2005), 355. The diameter of the smallest surviving astrolabe is only 4.9 cm.

12. Among different opinions, note Lewis (2001), 67–71; J. B. Harley and David Woodward (eds.), *The History of Cartography*, 2.1: *Cartography in the Traditional Islamic and South Asian Societies* (1992), 24–25 (by Emilie Savage-Smith).

The earliest surviving astrolabes are Eastern Islamic designs. We have no more than approximately two dozen from the formative period of Islamic science between around 800 and 1100 CE, although they must have been made in far greater numbers; they also form the subject of dozens of surviving treatises on their construction and use.¹³ Most of the surviving ones are signed by their maker, and even dated.¹⁴ Otherwise, however, there is no knowing how and where they were made, or by whom they were used and for what purposes. David King is nonetheless certain that the vast majority of them never served a practical role, but rather were valued as aesthetically pleasing collectors' pieces.¹⁵

Like a portable sundial, an astrolabe is suspended to function.¹⁶ Its purpose is to furnish a two-dimensional model of the sky at a particular latitude or zone. So, under the open-work star map that forms the top plate (the "rete"), must be placed another plate (the "tympanum"), which shows the tropics, equator, and horizon for that latitude or zone. More than one plate would commonly be made for an astrolabe, and the plates not required whenever the astrolabe was in use would be kept in its recessed base, referred to as the "mater" (Fig. 5.1A). For the only surviving astrolabe inscribed in Greek (dated 1062), there are three known plates marked respectively for Rhodes at latitude 36, the Hellespont at 40 (Fig. 5.1B), and Byzantium at 41.¹⁷ It is important to appreciate, however, that the primary indicator in each instance here is in fact a numbered zone ("klima") followed by the preposition *dia* ("for") and the name of the location in the genitive. The zone number for Rhodes is 4, and for both the Hellespont and Byzantium 5.¹⁸ To produce separate plates for the latter two locations in the same zone might seem excessive, but that was manifestly the choice of the designer or owner, and there is no knowing how many more plates were made for this astrolabe.

In the case of both Eastern and Western Islamic early astrolabes, the regular practice was in fact to provide a separate plate for each of the seven zones envisaged by Greek geographers so that the instrument could in principle function anywhere across a vast arc of space like a geographical portable sundial.¹⁹ As in the Greek instance just noted above, the latitudes of important locations might be borne in mind (Mecca and Medina, for example), but as King explains,

13. King (2005), 357, 366, 1005–6.

14. Ibid., 925.

15. Ibid., 363, 355.

16. Ibid., 347–55 for description of the components and their workings.

17. O. M. Dalton, "The Byzantine Astrolabe at Brescia," *PBA* 12 (1926): 133–46 at 138–39, with King (2005), 364–66. Diameter of its base: 37.5 cm.

18. Thus ΚΛΙΜΑ Δ ΔΙΑ ΡΟΔΟΥ. The number of hours in the longest day at each location is also recorded (Rhodes 14.5, Byzantium and Hellespont both 15).

19. *BNP* s.v. Zone 2 (by Wolfgang Hübner).

“When place-names were introduced on plates it was understood that these localities were best served by that particular plate, not that the localities all had the latitude indicated on that plate.”²⁰ In this respect the design matches that of the Vienna pillbox sundial.²¹ In order to tell the time at a particular location, the owner of that sundial had first to determine which of the removable discs—made for a range of regions and cities spanning Britain to Egypt—would be most appropriate to use for the purpose.

Many later Islamic and European astrolabes include on their base a list of locations with their latitude and even longitude,²² but such a gazetteer is found on only one surviving astrolabe made before around 1100. Its base alone survives,



FIGURE 5.1A Recessed base (“mater”) of the sole surviving astrolabe inscribed in Greek, with the open-work star map (“rete”) and the plate (“tympanum”) marked for the Hellespont both inserted. The plate is shown separately in Figure 5.1B below. This astrolabe is dated 1062. Museo del Età Cristiana, Brescia, Italy (Inv. Strum. Scient. no. 36).

Photo: Archivio fotografico Civici Musei di Brescia.

20. King (2005), 369; cf. 351, 924–25.

21. Compare also the design of the Philippi sundial (no. 11) as discussed above in Chapter 2.

22. King (2005), 924, 356, and (for Western Islamic examples) 934–35.

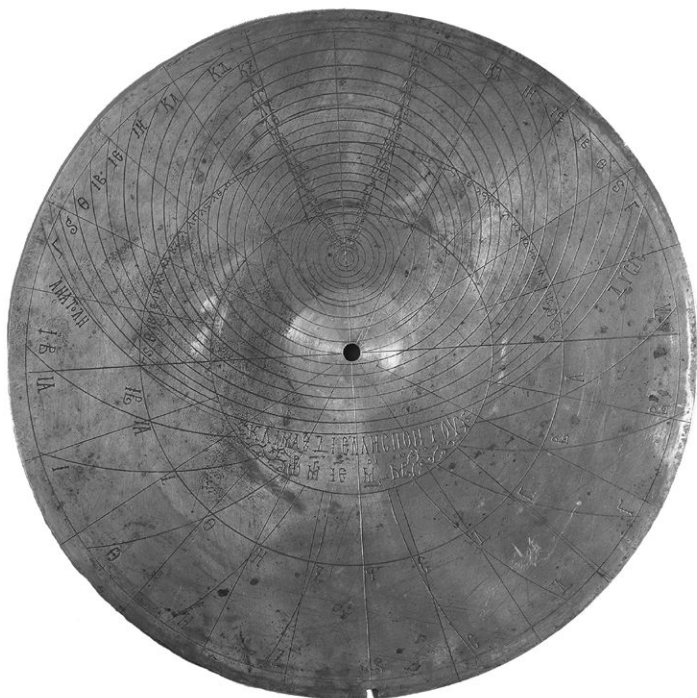


FIGURE 5.1B Plate (“tympanum”) marked for the Hellespont, a component of the sole surviving astrolabe inscribed in Greek (see Fig. 5.1A above).

Photo: Archivio fotografico Civici Musei di Brescia.

the work of Naṣṭūlus around 925 (Fig. 5.2).²³ His list furnishes the names and latitudes for sixty-four locations, with Mecca and Medina at 21 and 24 respectively, Tiflis at 41, and the rest all between 30 and 37 (no fractions).²⁴ The sources for such lists—their figures by no means always accurate—undoubtedly include Ptolemy’s *Geography*, but are altogether impossible to identify with confidence.²⁵

Sundials and other scientific instruments such as the astrolabe noted above continued to be made in the Greek East during the Byzantine period,²⁶ but no geographical portable sundial of the Roman type has surfaced. Nor is any attested as yet from the medieval Latin West. Here, awareness of latitude and longitude did persist, although it was for the most part confined to special-

23. Ibid., 932 (#1130 = 4023); Thomas Hockey et al. (eds.), *The Biographical Encyclopedia of Astronomers* (2007), s.v. Naṣṭūlus: Muḥammad ibn ‘Abd Allāh (by Mónica Ruis).

24. King (2005), 476–81.

25. Note the caution expressed by King (2005), 938–39. See further E. S. Kennedy and M. H. Kennedy, *Geographical Coordinates of Localities from Islamic Sources* (1987).

26. For an overview, see Turner (1994), 57–65.



FIGURE 5.2 Recessed base (“mater”) of the sole surviving astrolabe produced before around 1100 that includes a gazetteer; it lists in Arabic sixty-four locations with their latitudes. Its maker was Naṣṭūlus, around 925. Its diameter (13 cm) matches that of the largest surviving Roman geographical portable sundials (Mérida and Time Museum). Museum of Islamic Art, Cairo, Egypt, inv. no. 15351.

Photo: Alain Brieux Librairie, Paris, and David King.

ists with an interest in astronomy or astrology.²⁷ Knowledge of sundial making long remained limited and rudimentary.²⁸

2. The *Navicula* and “Regiomontanus” Types

In western Europe, an adjustable portable sundial incorporating geographical data is found for the first time, it seems, in the so-called *navicula* or *navicula de*

27. See Patrick Gautier Dalché et al., *L’Atelier du médiéviste 13, La Terre: Connaissance, représentations, mesure au Moyen Âge* (2013), 165, 219–41.

28. Although the silver Saxon portable sundial excavated in the cloister courtyard of Canterbury cathedral in 1938 is not geographical, it is comparable to the cylinder type mentioned above; see briefly Hester Highton, *Sundials: An Illustrated History of Portable Sundials* (2001), 19–20, 133. For fixed sundials, see David Scott and Mike Cowham, *Time-Reckoning in the Medieval World: A Study of Anglo-Saxon and Early Norman Sundials* (2010).

venetiis type. Five examples survive, one of them evidently unfinished, and another is reported in a late-eighteenth-century publication.²⁹ The Latin name “little ship” refers to the shape of the object; the additional reference to Venice may be no more than a nod to its importance as a port and commercial center for luxury goods. In the three most developed examples of this type (including the one illustrated here, Figs. 5.3A and 5.3B), a latitude scale is inscribed on the front of the mast, while on its back appears an almost identical list of five English cities,³⁰ each with a latitude figure, which in the case of London is as precise as 51° 34'. However, the user is free to choose any latitude on the scale, and the “collar” on the mast may be moved there accordingly. Where this type originated, and when, is uncertain, but England between the late thirteenth



FIGURE 5.3A Greenwich *navicula* portable sundial, front. Unearthed by chance at Sibton Abbey in Suffolk, UK, in 1989; now in the National Maritime Museum, Greenwich, London (inv. no. AST1146). Width 5.1 cm from 12 to 12 on the hour lines at the middle; height 4.9 cm from the 60-degree line to the mast pivot (see the back, Fig. 5.3B).

Photo: National Maritime Museum, Greenwich, London.

29. See in brief Higton (2001), 26–30; more fully, Catherine Eagleton, *Monks, Manuscripts and Sundials: The Navicula in Medieval England* (2010); and for the unfinished example, Turner (2007), 22, 60–63.

30. Eagleton (2010), 43–47: York, Northampton, Oxford, London, and Exeter, except in one instance where Winchester replaces Exeter.



FIGURE 5.3B Greenwich *navicula* portable sundial, back. The list of five cities (York, Northampton, Oxford, London, Exeter), each with its latitude on the line below the name, is inscribed downward from near the top of the mast; one name (Northampton) occupies two lines.

Photo: National Maritime Museum, Greenwich, London.

and late fourteenth centuries appears a credible claim.³¹ By what criteria the cities named were chosen, and from what sources their latitudes were derived, remain open questions. Equally indeterminable is the issue of how extensive the production of the *navicula* type became. Because so few examples are known, it is easy to imagine that it remained a rare type. Nonetheless, any such assumption is challenged by the fact that as many as sixteen manuscript copies—mostly from the fifteenth century—of five treatises about the *navicula* can be identified.³² Even so, this level of scholarly interest may not necessarily have led to a marked increase in production. Several of the manuscripts include lists of cities with their latitudes; these lists can be quite extensive, with a scope that extends beyond England and even encompasses such cities of historical or cultural significance as Alexandria, Babylon, Carthage, and Jerusalem.

More or less contemporary with the *navicula* type, although never widely made, is the “Regiomontanus” adjustable portable sundial. It was

31. Ibid., 4.

32. Ibid., 23–25.

called thus after Johannes Müller of Königsberg, Germany (1436–1476),³³ who first described it in his *Kalendarium* or almanac published in Nuremberg in 1474 (pages not numbered).³⁴ This sundial incorporates an articulated arm that can be moved anywhere across a nearly triangular grid (*trigon*) where horizontal lines mark out latitudes. Regiomontanus' own sketch (Fig. 5.4) limits itself to the range latitudes 39 to 54, and only draws lines at 3-degree intervals (42, 45, 48, 51) within that. Even so, the range could readily be extended, and the intervals made more frequent, as in the superb example shown here, made at Minden, Germany, by Johannes Krabbe in 1584 (Fig. 5.5).³⁵ Regiomontanus' sketch is too rudimentary to include a list of places with their latitudes as an aid to users, although he does in fact provide a *Tabula Regionum* earlier in the *Kalendarium*—the names of sixty-two

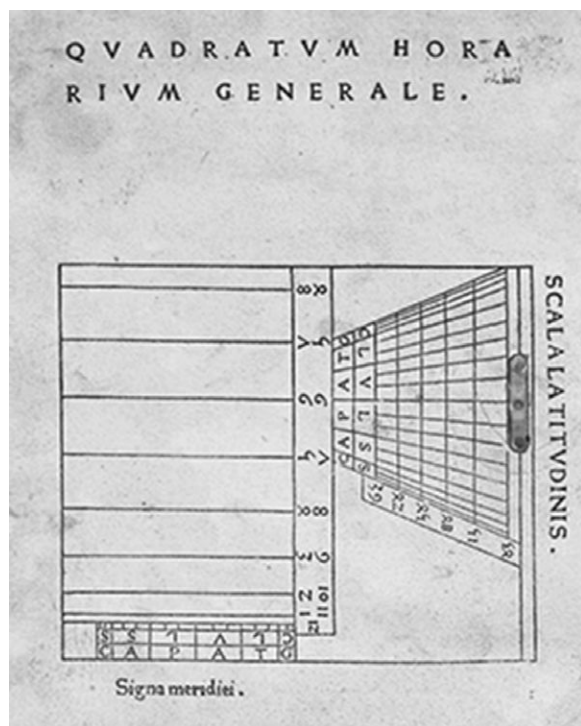


FIGURE 5.4 Design for an adjustable portable sundial sketched and published by Johannes Müller (Regiomontanus) in his *Kalendarium* (1474).

Kalendarium (Nuremberg, 1474), unnumbered page.

33. The Latin name (from Königsberg) was devised posthumously to identify him.

34. See Higton (2001), 24–26, for a brief overview of this type.

35. Higton (2002), 246–47.

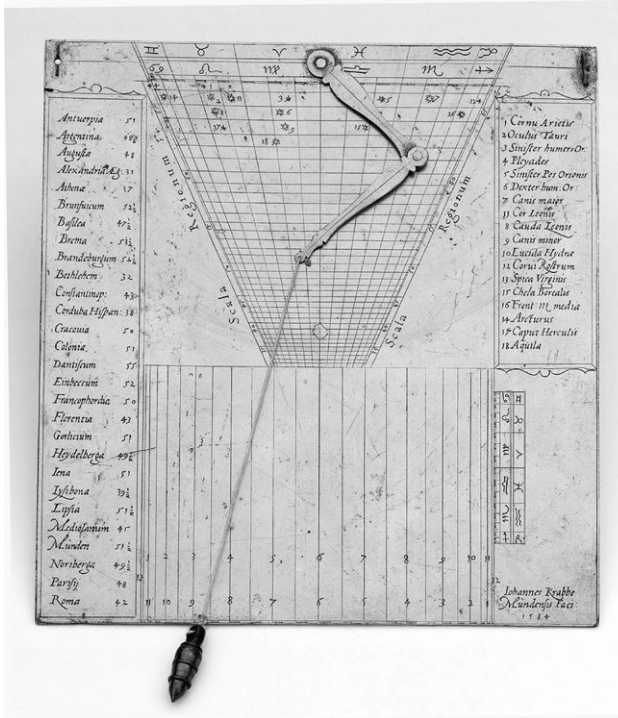


FIGURE 5.5 Gilt-brass Regiomontanus sundial produced by Johannes Krabbe at Minden, Germany, in 1584. Width 15.1 cm, height 16.1 cm. Now in the National Maritime Museum, Greenwich, London (inv. no. AST0370).

Photo: National Maritime Museum, Greenwich, London.

European cities, islands, and regions, with their latitudes.³⁶ Krabbe's sundial incorporates such a list to the left of the grid, comprising twenty-eight cities with their latitudes, even to half a degree in ten instances. These cities chosen by him or his client are mostly in Germany or central and western Europe, but Alexandria in Egypt, Athens, and Bethlehem are also among them.

3. Nuremberg Sundials

Knowledge of making and using sundials, along with a worldview rooted in Greek scientific principles, hardly improved and spread widely in western Europe before the fifteenth century, when cosmography (both celestial and

36. Observe the careful distinction that the list makes for the reader between Vienna prouicie and Vienna Pannonie.

terrestrial) and dialing grew to become mutually reinforcing passions.³⁷ Translation of Ptolemy's *Geography* into Latin early in the century (under the title *Cosmographia*), followed by its circulation in manuscript copies and eventually in print from the 1470s, was undoubtedly one widespread influence.³⁸ It in turn must have contributed to the popularity of the portable "compass" diptych sundials for which Nuremberg (Nürnberg), Germany, became the best known center of manufacture from around the 1480s through 1700; some were also made in France at Dieppe and Paris.³⁹

Such Nuremberg sundials are typically rectangular in shape (hence the alternative name "tablet dials"), and seldom as small as the Roman ones. Mostly they were made in ivory, but also in wood (with some brass components in both instances), according to strict rules developed by a guild of craftsmen (Fig. 5.6).⁴⁰ The magnetic compass set into the lower leaf of the diptych was of course a feature unknown in antiquity. With the two leaves first opened at right angles to one another, and the lower leaf lying horizontal, the compass then enables the user to ensure a north-south alignment for the string that serves as a shadow caster. Again typically from the early sixteenth century, in many instances the string could be adjusted up and down to permit accurate time telling at different latitudes. Often, however, this flexibility was reduced by provision of holes in the upper leaf through which to thread the string at no more than 3-degree intervals, as on the example made by Paul Reinmann illustrated here.⁴¹

To us, these sundials clearly recall the Roman geographical type in their listing on the upper tablet of cities, islands, and regions, each accompanied by a latitude figure. Among the many surviving examples from Nuremberg, the lists may comprise as few as fifteen such names and as many as one hundred, normally between latitudes 42 and 54, although sometimes a few degrees further in each direction.⁴² By what means the makers obtained their latitude figures is again unknown, although in Nuremberg expert informants would not have been hard to find, and in general reasonable accuracy by contemporary standards is evident. There was in any case most probably some fudging or rounding of figures in instances (such as that shown here) where no more than a few holes were provided;

37. Bennett (2009), 7–9 stresses the vigorous impact of this linkage.

38. See David Woodward (ed.), *The History of Cartography*, 3.1: *Cartography in the European Renaissance* (2007), 285–342, 361 (by Patrick Gautier Dalché); note the point (p. 298) that in this period the *Geography* was valued above all for its place names. For the *Geography* in Latin, see further Stückelberger, Mittenhuber, et al., (eds.), *Klaudios Ptolemaios Handbuch der Geographie: Ergänzungsband* (2009), 356–81 (by Klaus Geus and Doris Oltrogge).

39. Lloyd, *Ivory Diptych Sundials 1570–1750* (1992); overview by Higton (2001), 47–58, 87–94.

40. For a detailed account, Penelope Gouk, *The Ivory Sundials of Nuremberg 1500–1700* (1988), 65–81. See further Higton (2002), 261–95.

41. Described by Ernst Zinner, *Deutsche und Niederländische astronomische Instrumente des 11.–18. Jahrhunderts*, ed. 2 (1967), 489.

42. See Higton (2002), 269–70, for an example with a list of one hundred names (c. 1600).

eighteenth century comparable complex instruments were produced in metal—normally gilt brass, but also silver—at Augsburg and London in particular.⁴³

4. Scottish Stone Sundials

Because the location or latitude for which a fixed sundial was designed is seldom stated on it either during classical antiquity or thereafter, certain fixed Scottish stone sundials featuring a range of locations in the manner of portable ones attract attention. They are among the three hundred or more surviving examples attesting to an unparalleled enthusiasm for elaborately carved monumental sundials in Scotland during the seventeenth and early eighteenth centuries.⁴⁴ Three main types are identified: lectern, obelisk, and facet head (ranging from simple cube



FIGURE 5.7A Cantray sundial, “front”; height (on a pedestal) extends to 1.63 m, width to 43 cm. Now in the National Museum of Scotland, Edinburgh, inv. H.NL 64.

Photo: National Museums Scotland.

43. See Higton (2001), 56–66, 79–84, 96–108, 113–15; Mark Lennox-Boyd, *Sundials: History, Art, People, Science* (2005), 51–55.

44. See A. R. Somerville, *The Ancient Sundials of Scotland* (1990); more briefly, Lennox-Boyd (2005), 118–20.

to complex polyhedral). A period of more settled government and greater prosperity, which prompted the gentry to build mansions with formal gardens, was the context in which the enthusiasm grew. But the prevailing Calvinist outlook, which deplored mere decoration and insisted on purposeful function, also exerted its influence. So, too, did an appetite for science and philosophy. The appeal of Freemasonry—known for its concern with symbology, which these sundials in turn reflect—may have furnished additional impetus. Engagement, whether real or wishful, with a wider world certainly played its part in instances like the one illustrated here: the eighteenth-century lectern sundial in gray sandstone from the grounds of a mansion at Cantray, a few miles east of Inverness, almost at latitude 58.⁴⁵ Its design incorporates dials to show the time at a splendidly idiosyncratic mix of historical and contemporary locations across the globe on four sides, as follows:

Rome, Jerusalem, Cairo, Pekin, Goa (Fig. 5.7A)
 Troy, Ozaca, Naples & Syracuse (Fig. 5.7B)
 Smyrna
 Bengal, Paris



FIGURE 5.7B Cantray sundial, “back.”

Photo: National Museums Scotland.

45. Somerville (1990), Catalogue p. B14/27.

5. The Twentieth Century and Beyond

As clocks and watches could be made increasingly reliable and affordable during the nineteenth century, widespread production of sundials in great quantities all but ceased, whether fixed or portable. Once dependable clocks and watches became commonplace, sundials were no longer even needed to regulate their timekeeping or to reset them when they stopped.⁴⁶ One final initiative in the design of sundials for mass production should be noted, however, for its continued inclusion of geographical data on the object itself. This is a brass “Sunwatch,” first patented by the Ansonia Clock Company of New York around 1920 and manufactured by it until 1929, when the Outdoor Supply Company continued producing it for a further period (Fig. 5.8A).⁴⁷ It was deliberately kept a low-price item for widespread sale, initially \$1 in the United States, where two versions were available; three others were produced for Australia and New Zealand, Canada, and the British Isles (United Kingdom and the Irish Free State) respectively. “Every Scout and Sportsman needs a Sunwatch to complete his equipment,” advertisements urged—a claim that recalls Oswald Dilke’s estimate of the portable sundial’s value to the Roman traveler quoted in the Preface.

For certain, the Sunwatch is an admirably compact, shiny, boxlike item (7.6 cm long x 5, with a depth of 1 cm), which contains a small inset compass together with a shadow caster that fits into a slot in the base plate when not in use. Once raised, the shadow caster can easily be set for three latitudes, marked 20, 30, and 40 for Australia and New Zealand; 35, 40, and 45 for the United States; 45, 50, and 55 for Canada; and 51, 54, and 57 for the British Isles. On the reverse of the lid a list comprising as many as forty-two cities in alphabetic order is furnished for reference,⁴⁸ each name followed by data for calculating the time (Fig. 5.8B).⁴⁹ Even so, the unbalanced version for the British Isles is limited to no more than thirty-three names, the work of a compiler evidently content to include in this reduced total as many as fourteen choices in Ireland, and only one in Wales.⁵⁰ The length of these lists, not to mention the selectivity

46. On this important, long-standing function, which had motivated designers of sundials to strive for increasing accuracy, see Higton (2002), 15–23 (by Anthony Turner). In very remote locations, of course, this function might still be called for; note Ogle (2015), 82.

47. Higton (2001), 125–26; www.compassmuseum.com/sundials/sundials.htm.

48. In one U.S. version, forty-two names, beginning with Atlanta GA and ending with Wichita KAN (*sic*); in the other, thirty-one names from Albany NY to Wilmington NC.

49. Summarized by Higton (2001), 125–26. An instruction booklet was supplied with each Sunwatch.

50. The more balanced lists for both the Canada (total of forty-one names) and the Australia and New Zealand (forty-two names) versions are subdivided by province/state and country. The Canadian total in fact includes two names in Newfoundland (not part of Canada until 1949) and one in Alaska; none in the Yukon. There are seven names in New Zealand.

manifestly exercised in compiling the one for the British Isles, is comparable to what may be found on Roman portable sundials therefore, although they were typically not mass-produced.

Today, among the marvels that twenty-first-century technology and artistry have the capacity to offer are wristwatches with instant adjustment mechanisms for multiple time zones (Fig. 5.9), as well as others with a display of several continents and five dials, making it possible to check at a single glance the time in that many locations scattered across the globe (Fig. 5.10). To be sure, owners of these modern matches for the Roman portable sundial may find themselves exposed to the type of query that had no doubt also been addressed to their ancient forerunners by philistines content to check the time merely by glancing up at the sun. Take the question posed in 2007 to Ngozi Okonjo-Iweala soon after her appointment as managing director of the World Bank: “Who could possibly need a watch with five faces?” Far from showing any trace of embarrassment or dismissiveness, her response rather drew attention candidly to the watch’s practical assistance in discharging her many responsibilities, professional and personal, worldwide:

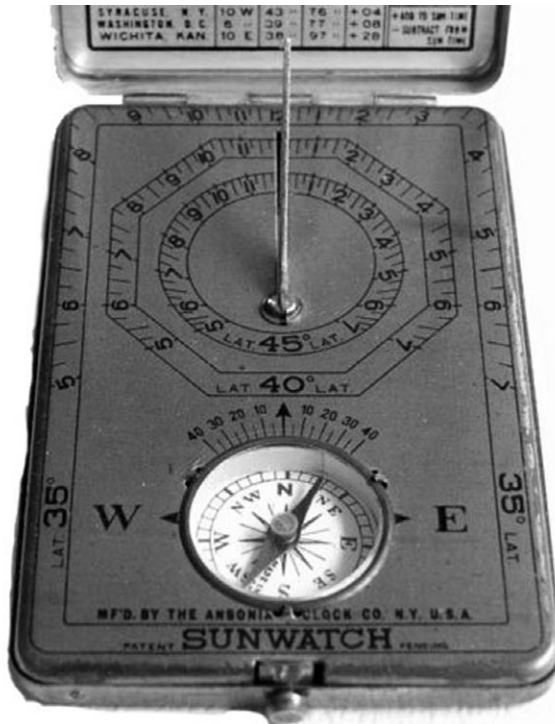


FIGURE 5.8A Ansonia Sunwatch dial plate.

Photo: author.

PLACE	VAR.	LAT.	LONG. COR. MIN.	EQUATION
ATLANTA, GA.	2° E	34° N	84° W +36	DATE COR. M.
BIRMINGHAM, ALA.	4 "	34 "	87 " -12	JAN. 1 + 3
BOISE, IDAHO	20 "	44 "	116 " -16	" 8 + 7
BOSTON, MASS.	14 W	42 "	71 " -16	" 15 + 9
BUFFALO, N. Y.	7 "	43 "	79 " +16	" 22 +12
BUTTE, MONT.	20 E	46 "	113 " +32	" 29 +13
CARSON CITY, NEV.	18 "	39 "	120 " 00	FEB. 3 +14
CHARLESTON, S. C.	1 W	33 "	80 " +20	" 26 +13
CHICAGO, ILL.	2 E	42 "	88 " -08	MAR. 1 +12
CINCINNATI, OHIO	0	39 "	84 " -24	" 15 + 9
CLEVELAND, OHIO	4 W	41 "	82 " +28	" 30 + 5
DALLAS, TEX.	9 E	33 "	97 " +28	APR. 4 + 3
DENVER, COL.	15 "	40 "	105 " 00	" 15 0
DES MOINES, IOWA	8 "	42 "	94 " +16	" 25 - 2
DETROIT, MICH.	2 W	42 "	83 " -28	MAY 1 - 3
FARGO, N. D.	11 E	47 "	97 " +28	" 15 - 4
INDIANAPOLIS, IND.	1 "	40 "	86 " -16	JUNE 4 - 2
JACKSON, MISS.	7 "	32 "	90 " 00	" 15 0
JACKSONVILLE, FLA.	1 "	30 "	82 " +28	" 24 + 2
KANSAS CITY, MO.	9 "	39 "	95 " +20	" 30 + 3
LITTLE ROCK, ARK.	7 "	35 "	92 " +08	JULY 4 + 4
LOS ANGELES, CAL.	16 "	34 "	118 " -08	" 10 + 5
LOUISVILLE, KY.	1 "	38 "	86 " -16	" 31 + 6
MILWAUKEE, WIS.	3 "	43 "	89 " -08	AUG. 11 + 5
MINNEAPOLIS, MINN.	9 "	45 "	93 " +12	" 17 + 4
NASHVILLE, TENN.	4 "	36 "	87 " -12	" 25 + 2
NEW ORLEANS, LA.	6 "	30 "	90 " 00	SEP. 1 0
NEW YORK, N. Y.	10 W	40 "	74 " -04	" 10 - 3
NORFOLK, VA.	6 "	37 "	76 " +04	" 18 - 6
OMAHA, NEB.	10 E	41 "	96 " +24	" 30 -10
PHILADELPHIA, PA.	9 W	40 "	75 " 00	OCT. 6 -12
PHOENIX, ARIZ.	15 E	33 "	112 " +28	" 15 -14
PITTSBURGH, PA.	5 W	40 "	80 " +20	" 26 -16
PORTLAND, ME.	16 "	44 "	70 " -20	NOV. 22 -14
PORTLAND, ORE.	23 E	45 "	123 " +12	DEC. 1 -11
ST. LOUIS, MO.	5 "	39 "	90 " 00	" 9 - 8
SALT LAKE CITY, UTAH	17 "	41 "	112 " +28	" 17 - 4
SAN FRANCISCO, CAL.	18 "	38 "	122 " +08	" 25 0
SEATTLE, WASH.	23 "	48 "	122 " +08	
SYRACUSE, N. Y.	10 W	43 "	76 " +04	+ADD TO SUM-TIME
WASHINGTON, D. C.	6 "	39 "	77 " +08	-SUBTRACT FROM SUM-TIME
WICHITA, KAN.	10 E	38 "	97 " +28	

FIGURE 5.8B Ansonia Sunwatch name list (Atlanta to Wichita).

Photo: author.

The Nigerian said she bought it while negotiating debt relief with the Group of Eight countries as finance minister between 2003–6. “I had to keep ringing ministers round the world at a set time and if I was five minutes late they would have left. So I needed five time zones. Now I have US, because I need to know what my children and husband are up to [in] Europe, London, South Africa and Japan.”⁵¹

Okonjo-Iweala did not cite any less-tangible value of the kind that traditional Swiss watchmakers have been promoting in their struggle against digital time-pieces from the 1970s onward. The *New York Times* obituary of Raymond Weil (1926–2014), head of the company he founded bearing his name, praised his

51. *Financial Times*, Dec. 12, 2007; see further her remarks, *ibid.*, June 6/7, 2015.



FIGURE 5.9 Richard Mille 58-01 Tourbillon World Timer Jean Todt limited edition, 2015. As on Roman sundials, the spread of the twenty-four names here may be vast, but the choices are still an eclectic mix. All are cities or islands, except for one large country (Mexico). U.S. territory is favored, together with Asia and the Pacific. The Azores, Midway, and South Georgia are included, but not Moscow or Beijing or anywhere in Africa.

Photo: Richard Mille.

successful efforts to market luxury Swiss watches—retailing from US\$500 well into six figures—as “paragons of haute fashion, an emotional product, carrying a message about the authenticity, uniqueness and excellence of the wearer.”⁵²

In a similar vein, the globe-trotting pop star and passionate, serious watch collector John Mayer has spoken of his watch as a grounding mechanism, a home base: “I remember thinking—and this is a very important feeling—that I could go anywhere with this watch, because I couldn’t be lost.”⁵³ While Mayer

52. Ryan Raffaelli (Harvard Business School), quoted in the obituary by Paul Vitello, *New York Times* Feb. 5, 2014.

53. Interview with Alex Williams, *New York Times* May 1, 2015, p. D12. The sentiment recalls that of Samuel Pepys, quoted in Chapter 4 section 3.

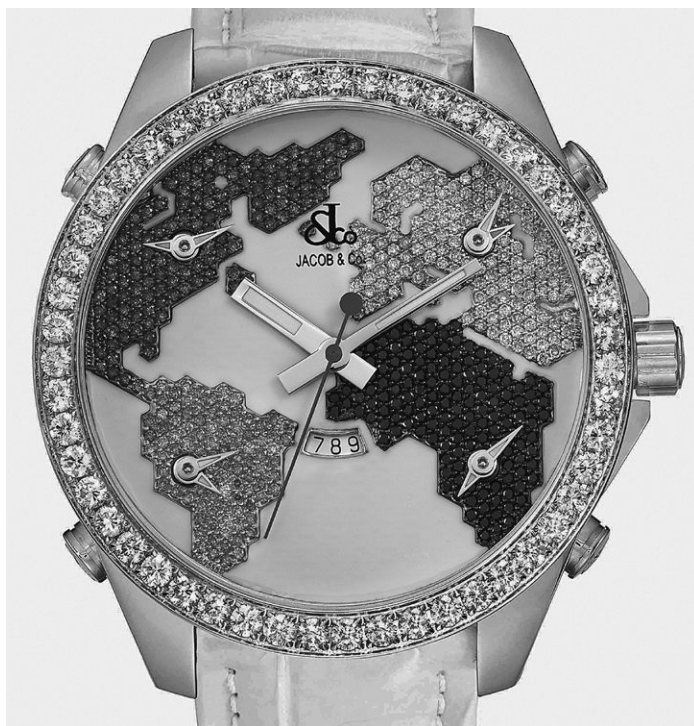


FIGURE 5.10 Jacob & Co. Diamond Bezel Five Time Zone Watch (JC47YB).

Photo: Jacob & Co., New York.

has openly indulged the urge to commission expensive unique pieces from the Geneva maker Patek Philippe,⁵⁴ at the same time he also admits to gaining immense pleasure and satisfaction from the sense of being just one enthusiast among many in the “watch community.” He would readily understand the appeal of the assurance urged by Patek Philippe in its advertisements: “You never actually own a Patek Philippe. You merely look after it for the next generation.” In antiquity such successive ownership (and enhancement) may well have left its mark on the reverse of the Oxford sundial (no. 7), as we have seen in Chapter 2. More generally too, we may fairly imagine that Roman owners valued their geographical portable sundials for reasons very much like those that engage today’s watch community. Then, as now, the scope of those reasons extends far beyond just telling the time.

54. www.patek.com.

Appendix

The Aquincum Fragment: A Sundial Maker's Manual?

As noted in Chapter 4 section 4, the lists of names on geographical portable sundials inscribed in Greek include Rhodes in six instances, and Syene in five; no Latin list includes either name. It is noteworthy, therefore, to find the names Syene (SVENIS) and Rhodes (RODO) inscribed in Latin and placed in relation to two of nine arcs on a marble fragment that was unearthed in 1990 during excavations of an area near the Roman legionary fortress at Aquincum (*BAtlas* 21 B2, modern Budapest). Finds of marble objects here are rare, and all of them are imports. The nature and purpose of this one—an unparalleled record or manual—invite speculation; it is tempting to propose some connection with the production of sundials. The only discussions of the fragment—a pair of thorough, perceptive articles published in 1993 by the excavator Orsolya Madarassy and her colleague Ferenc Noéh—raise this possibility, but do not develop it.¹ In part because Madarassy used the descriptive term “*tabula gromatici*” in the title of her article, scholars with an interest in sundials were not alerted to it. Although *gromaticus* is most readily taken to signify the Late Antique term for a

1. Ferenc Noéh, “Fragment of a Measuring Instrument from Aquincum,” *Budapest Régiségei* 30 (1993): 293–95; Orsolya Madarassy, “*Tabula Gromatici* from the Canabae of Aquincum,” *ibid.* 301–15 (following the original Hungarian text on 297–300). I draw on the descriptions and hypotheses in both articles with much gratitude. The fragment is also illustrated and described as “used for various engineering tasks” and as “part of a land surveying tool (gnomon)” by Paula Zsidi et al. (eds.), *Aquincumi Látványraktár/Visual Store at Aquincum* (2009), 54, 116, 205 (no. 348).

land surveyor, Madarassy intended it to mean—unconventionally, and much more generally—“an engineer in the legion’s engineering unit” (p. 301).

A wholly fresh inspection of the fragment is merited, along with reevaluation of the supposition that it was part of the equipment of a land surveyor or engineer. The fragment is in the Aquincumi Múzeum, Budapest, Hungary (inv. no. 94.I.K.31), where Dr. Annamária Facsády generously permitted RTI images to be made of it by Michael Fergusson in November 2013.² In Noéh’s words (p. 293), its material is “white marble with a cloud-like pattern of light grey graphite,” most probably from North Africa or Greece. It weighs 369 grams, with thickness varying between 1.3 and 1.5 cm; its approximate maximum extent is 12.7 by 11 cm. All four edges were broken in antiquity (randomly, it would seem), with no further breakage occurring in the course of the 1990 excavations. Both sides are inscribed.

The lines on *side* A are of varying weight (Figs. A.1, A.2, A.3). RTI images create the impression that on part of the surface toward the top right a plan with many straight lines intersecting had been inscribed previously (a building complex, or even a town perhaps?), and thereafter more or less thoroughly erased. The faint line no. 12 seems most plausibly regarded as part of that earlier plan (Fig. A.4).

Otherwise the space on side A is occupied for the most part by the firmly inscribed arc of what would have originally been at least a 180-degree semicircle. It is conceivable that the semicircle was continued further through 270 degrees (the start of a line no. 11 presumably to that point is just visible below the center point), and it could even have been completed to the full 360 degrees, although that quadrant of the arc too is (just) entirely missing from the fragment. At the circle’s center point, repeated placement of sharp points has created a shallow depression. From here, eleven radius lines are visible; nine of them survive for the full length of 61 mm. Of these, nos. 1 and 10 combine to form (it seems) a 12.2 cm diameter, and the same can be claimed of nos. 5 and 11, which run at right angles to nos. 1 and 10, thus dividing the circle into quarters.

Line no. 5 is doubly important. First, it continues beyond the circumference of the circle to mark an endpoint above—to be described shortly. Second, on either side of no. 5 are inscribed three radius lines fanning out at the same intervals of 11.5, 20, and 23.5 degrees from it (nos. 6, 7, 8 to the left, nos. 4, 3, 2 to the right). These lines are no doubt intended to mark the sun’s seasonal declinations in a style commonly seen on the obverse of portable sundials (no. 7, Oxford, for example). Of the six lines, only no. 8 continues—like no. 5—beyond the circumference of the circle, although the fragment cuts it off much earlier than no. 5. Further to the left of no. 8, a fourth radius line, no. 9, appears. By comparison with most other lines on either of the fragment’s sides,

2. RTI is explained at the start of Chapter 2.

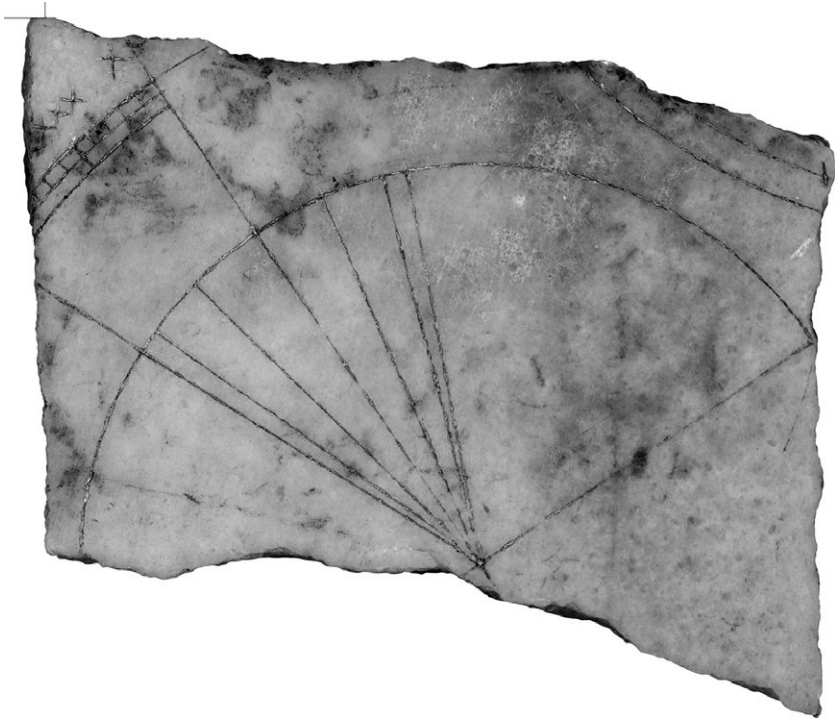


FIGURE A.1 Side A, RTI image.

Inv. 94.I.K.31, photo BHM Aquincum Museum, Budapest, Hungary, and Michael Fergusson.

it is inscribed lightly; it also seems to continue even more lightly to the right-hand edge and presumably beyond. Both nos. 8 and 9 are treated further below.

At an interval of 2.4 cm beyond the circumference of the circle just described, the line no. 5 intersects with three successive arcs inscribed at 2 mm intervals, and thus with radii of 8.5, 8.7, and 8.9 cm from the center point. The first two of these arcs do not continue to the right of no. 5, but the third (outermost) does—for an indeterminable distance, because the fragment breaks off. Further continuation of no. 5 (again, evidently beyond the edge of the fragment) then coincides with the letter C, which forms the second figure of the Latin numeral XC = 90; this letter, although only partially preserved, is not in doubt. A short way to the left of XC, the numeral XXX is inscribed, which can confidently be expanded to LXXX = 80. The likelihood is that all three arcs continue leftward far enough to take the sequence of figures down to zero, and that these figures represent degrees of latitude recorded clockwise. Between the outermost and middle arcs, 2-degree intervals are marked (thus 80, 82, 84, 86, 88, 90). At intervals of ten, the number is inscribed above (thus LXXX), and the mark immediately below it continues through the space between the middle and innermost arcs, which is otherwise left blank. Such an additional indicator is merely for the user's convenience. Several portable sundials mark

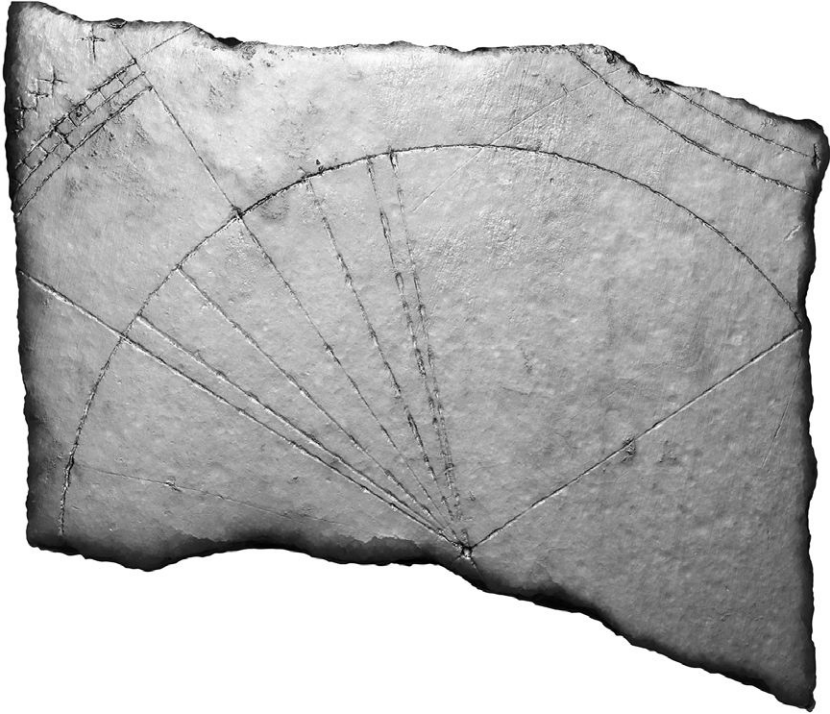


FIGURE A.2 Side A, RTI image with specular enhancement.

Inv. 94.I.K.31, photo BHM Aquincum Museum, Budapest, and Michael Fergusson.

latitude figures in a very similar way. Among sundials inscribed in Latin, Crêt-Châtelard offers the closest match (although with 90 rendered as LXXXX); among those inscribed in Greek, British Museum is the closest.

If line no. 8 did in fact continue as far as the three successive arcs inscribed at 2 mm intervals, it would intersect with them at latitude 66. Why that latitude was chosen—3 degrees beyond Ptolemy's figure for the northernmost land known to him, the island of Thule³—is an open question; conceivably, the intention is to register the divide between the *oikoumene* and the Arctic zone.

The faint line no. 9 seems more easily accounted for. If continued, it would intersect with the three successive arcs between latitudes 46 and 48. Given that the correct latitude of Aquincum, where the fragment was found, is 47 50, this line was no doubt added for use specifically there: compare the addition of a punch mark at latitude 43 on the Time Museum sundial, possibly made by a user at Constantinople. There is no knowing whether line no. 9 was added by the original designer or by a subsequent user.

At the top right of side A, two further arcs are inscribed. They are about 5 mm apart, and the minimum distance between the outer of the two and the

3. Ptol. *Geog.* 2.3.32 Stükelberger.

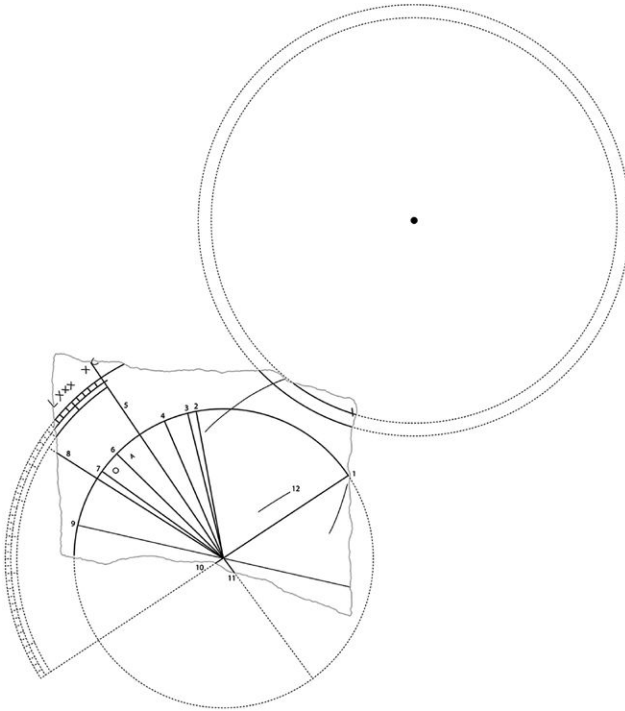


FIGURE A.3 Side A line work drawing.

Ancient World Mapping Center.

(semi)circle just described is 9 mm. Were each arc extended to form a circle, the radii would be 8.8 cm (outer arc) and 8.3 cm (inner arc); by comparison, the distance from the center point of the (semi)circle just described to the top of the numerals for latitude figures at the left of the fragment is about 9.7 cm.

There can be little doubt that side A's components were intended for practical use rather than to serve some merely decorative or commemorative function. Signs of such use are visible, through inspection of RTI images in particular. Even so, it can prove difficult to distinguish between leftover traces of whatever had once been inscribed toward the top right (such as line no. 12, as mentioned above); additions made by users (such as line no. 9 perhaps); scratches incurred in the course of normal wear and tear, not to mention after the eventual careless disposal of the slab (such as those that cut deeply through arcs 4–7 and 9 on side B); and traces that may really reflect no more than variations in the coloration of the marble. At the far right, a thin, faint line (unnumbered in Fig. A.3) curves down beyond the intersection of line no. 1 and the circumference of the circle; possibly it is a scratch rather than a purposeful addition. The same uncertainty arises with reference to the even thinner line at the top right of the fragment (also unnumbered), running between the two arcs there and the circumference of the circle below. By contrast, despite faintness,



FIGURE A.4 Side A specular enhanced zoom: line no. 12 center foreground, line no. 1 bottom right.

Inv. 94.I.K.31, photo BHM Aquincum Museum, Budapest, and Michael Fergusson.

there can surely be no cause to doubt the lightly incised letter *A*—whatever it may signify—to be detected between lines nos. 5 and 6. I suspect another such letter (*O*?) between nos. 6 and 7. And a second, slightly larger letter *A*—just above and to the right of the *A* already mentioned—also seems possible, though maybe it is merely a mirage created by the marble coloration at this spot. Last in this connection, while the mark visible at the righthand end of the outer arc at the top right is perhaps best regarded as no more than random damage to the fragment, it could instead be considered an incision of the type made purposefully along the arcs on side B. Certainly I am inclined to see the incision on line no. 9 (4.5 cm from the center point) as purposeful.

Much of *side B* of the fragment is blank, with less sign of earlier line work subsequently erased (Figs. A.5 and A.6).⁴ Running from top to bottom is a straight line serving as the radius of a circle, although it is impossible to say how many quadrants were drawn, if any, beyond the one preserved. This line must have continued at least some way further in each direction beyond the fragment as it survives; the full radius would be 10.7 cm (Fig. A.7). At the left of the fragment,

4. However, at the bottom left can be seen a lightly inscribed line running parallel to arc 1; beyond it, also at the bottom, at least three (radius?) lines are visible.

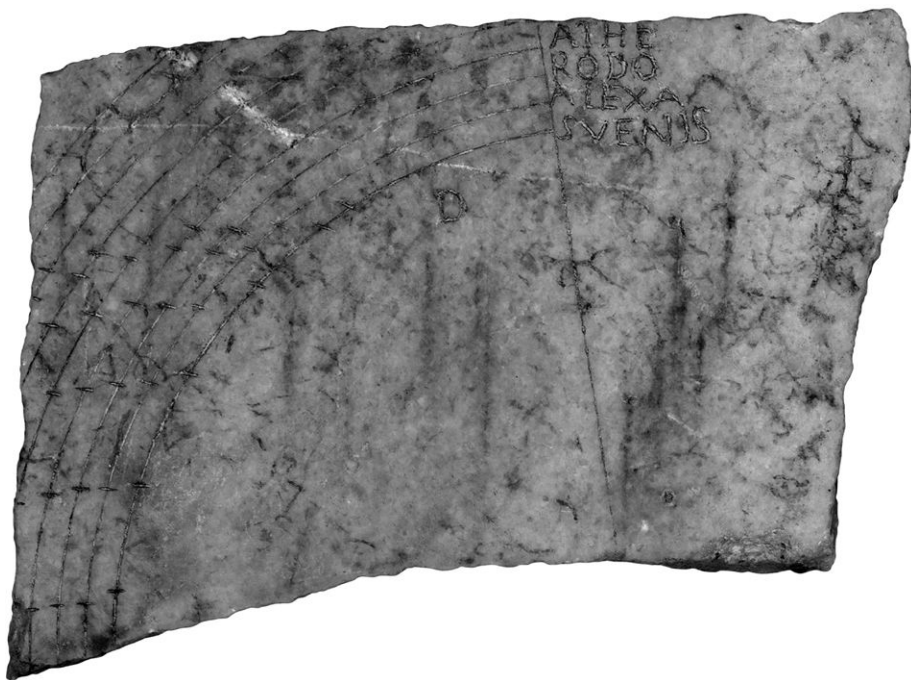


FIGURE A.5 Side B, RTI image.

Inv. 94.I.K.31, photo BHM Aquincum Museum, Budapest, and Michael Fergusson.

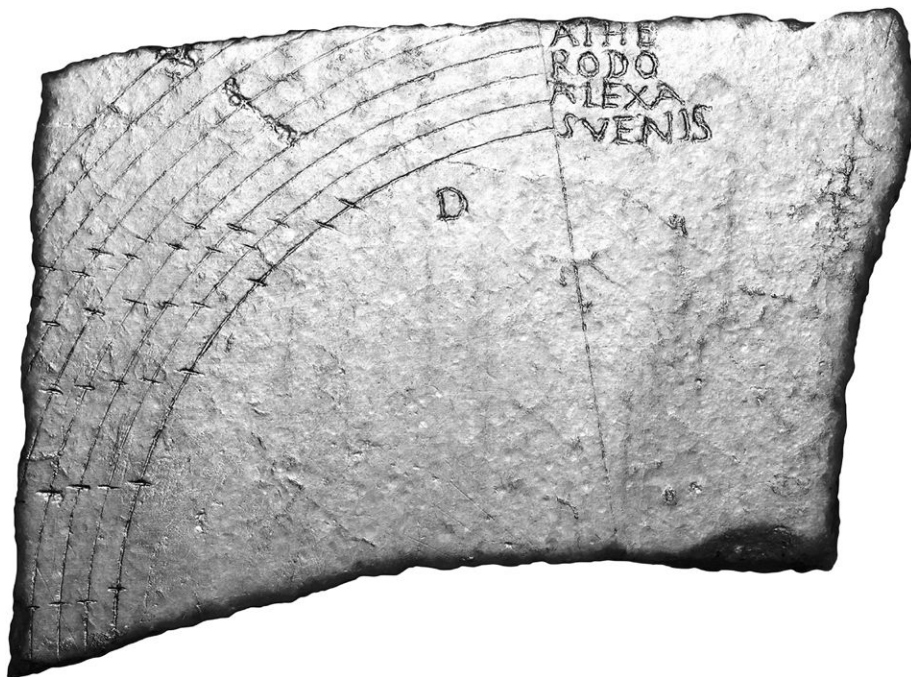


FIGURE A.6 Side B, RTI image with specular enhancement.

Inv. 94.I.K.31, photo BHM Aquincum Museum, Budapest, and Michael Fergusson.

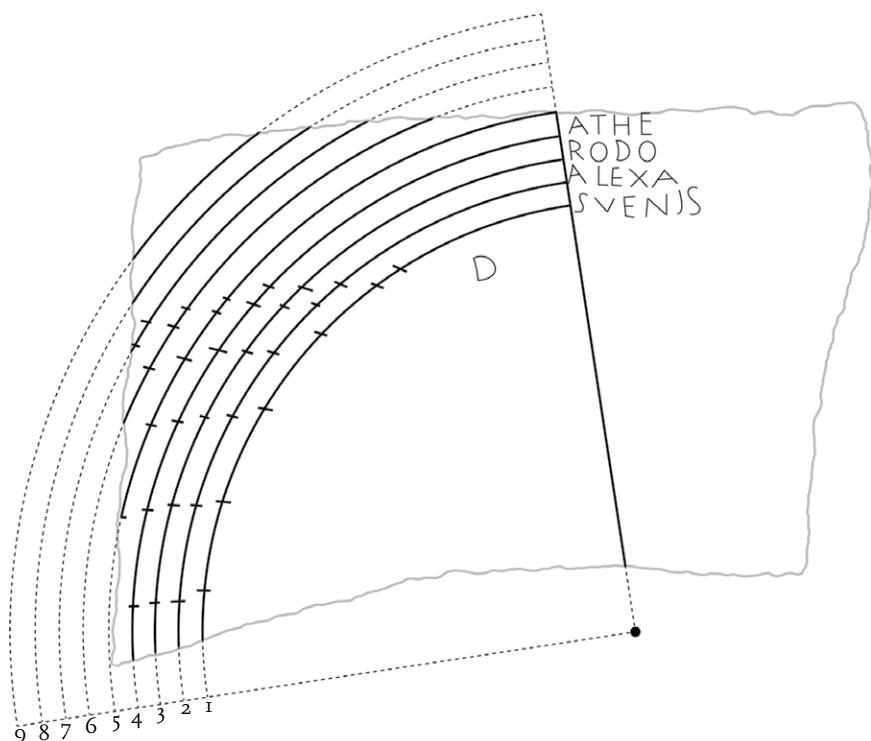


FIGURE A.7 Side B, line work drawing.

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nine arcs are inscribed at approximately 4 mm intervals, so that the distance from the center point of the circle to the first (innermost) arc is 7.4 cm, and to the ninth (outermost) 10.6 cm. Presumably there was no arc beyond this ninth, because a very short stretch of a tenth would still be visible if the regular interval between the other arcs had been maintained. Equally, we may assume that no arc extended to the right beyond the straight line, because it is clear that the innermost four arcs halt there. A geographical name in Latin (abbreviated in all but the first instance) then follows each of these arcs, from first to fourth: SVENIS,⁵ ALEXA, RODO, ATHE. Along all the arcs except the eighth and ninth (from which the least line work survives), short, straight incisions across the line work have been made very deliberately and conspicuously. Six incisions are visible along what survives of each of arcs 1 to 4, five incisions along arc 5, three along arc 6, and two along arc 7; no doubt there were originally six incisions made along each arc. There is no incision on what remains of arcs 8 and 9. The single letter D is inscribed approximately 1.4 cm to the right of the uppermost incision on the innermost arc (1), most probably to signify D(eclinatio).

5. Possibly a genitive form rather than nominative.

If the angle from the center point on the line running through the fragment to each incision (starting from the topmost) on arcs 1 to 7 is measured, the following approximate figures (latitudes) emerge:

1	2	3	4	5	6	7
24.3	31.7	35.3	38	42.1	45.6	48.9
28.1	35.6	38.6	40.7	44	47.8	51.5
37.8	43.7	45.6	47.3	50.1	52.9	
50.3	53.1	54.8	56.6	58.2		
63.9	65.1	66	67.3	68.7		
75.8	77.5	77.8	78.4			

Evidently these are arcs on altitude circles from the zenith to the position of the sun at the six successive seasonal hours before and after noon on the latitude at the chosen location; the topmost incision furnishes the latitude.⁶ As the Gazetteer demonstrates, the figures here for Syene, Alexandria, Rhodes, and Athens (arcs 1–4) are close matches to those recorded on geographical portable sundials, as well as more or less correct. By the same token, there is every likelihood that Rome (ROMA) was the city associated with arc 5, and Lugdunum (LVGD?) with arc 6 (or possibly Mediolanum). The likely choice for arc 7 is less obvious, just possibly Reginum (*BAtlas* 12 F3) or Durocortorum (*BAtlas* 11 E3), if a city rather than a region remained the designer's preference. For arcs 8 and 9, both the latitudes and the associated locations must be conjectured. But if for the sake of consistency the latitudes were to be around 52 and 55, locations in the south of Britain and in the area of Hadrian's Wall respectively could then be expected; the figure for Britain on several geographical portable sundials is 55 or higher. So LOND for Londinium (*BAtlas* 8 G3) and VALLVM or VAL(L) for the Wall (*BAtlas* 9 D6–F6), for example, might be the names chosen for arcs 8 and 9 respectively.⁷

From the fragment, it is not possible to explain why the components on each side are placed where they are, let alone what relation the designer intended between them, especially as we may well imagine the manual to have included additional components of which not the slightest trace survives (Fig. A.8). For certain, however, neither circle on side A has the same center point as the circle on side B, so the two sides do not relate in this way at least. Nor is it possible to infer from the fragment the overall dimensions originally required to accommodate even just the components visible on sides A and B. That said, if the two arcs at the top right of side A were completed to form a full circle, a

6. Cf. Ptol. *Almagest* 2.13.

7. On this name for Hadrian's Wall, see Breeze (2012), 54–55, with Figure 4.3 above.

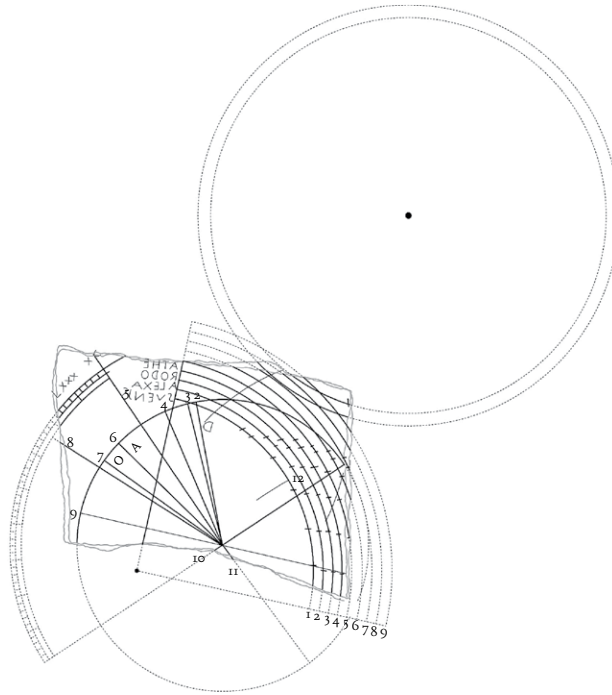


FIGURE A.8 Line work drawing of side A, with line work drawing of side B superimposed in reverse. Because the fragment's edges are uneven, the two sides do not make a precise match.

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surface measuring at a minimum 26.3 cm wide by 29.7 cm high would be needed for all the components visible on this side. However, were the two arcs to be extended for no more than one or two quadrants, correspondingly less space would then be needed, the exact amount depending on how far the extensions ran, and where. At the bottom of the fragment, if the (semi)circle described earlier were continued to 270 or 360 degrees, it is evident from Figure A.3 that only minimal further space would be needed. By contrast, on side B considerable further space would be essential in the (unlikely?) event that the single quadrant here were extended in either direction.

Side B, no less than side A, leaves the impression that it was inscribed for practical use. Altogether therefore, what survives amounts to components—on partially reinscribed marble—of a two-sided working manual useful not only for making sundials (both fixed and portable), but also perhaps for informing others about such instruments and their design. Indeed, a prime function of this manual could be to serve as a versatile teaching tool for instructing apprentices on the one hand, and interested clients on the other. It was most probably for such pupils that the letter D was inscribed on side B (an expert hardly needed that indicator); likewise the puzzling letter A, and possibly others, more

lightly inscribed on side A. As an object, the manual was neither too heavy nor too bulky for a traveling sundial maker to convey from place to place; moreover, exploitation of both its sides was an advantageous economy.

Manifestly, the manual had been put to creative use at Aquincum, where it was eventually discarded sometime during the second or third centuries CE, in Madarassy's opinion.⁸ A conspicuous feature is the distinct concern of whoever designed it—be that its user at Aquincum, or a predecessor—to encompass the West and North of the Roman world in the choices of names associated with the arcs on side B.⁹ Although nothing closely comparable to this object is known, the existence of such an enterprising sundial maker's portable manual should hardly be cause for surprise. Rather, this identification sheds welcome light on the means by which knowledge about the design and workings of sundials was spread, as discussed in Chapter 4 section 4.

8. Madarassy (1993), 301.

9. Cf. Chapter 4 section 2.

Gazetteer

All the locations named on the geographical portable sundials described in Chapter 2 are listed here alphabetically in the anglicized forms used there. The locations are divided into four groups for ease of comprehension:

1. Cities
2. Cities or islands or provinces or regions (the style of the name on the sundial does not distinguish)
3. Mediterranean islands or provinces
4. Provinces or regions

In addition, three latitude figures preserved without a recoverable name are listed separately at the start, together with one inferred latitude range also without a name.

The figure(s) in the far left column are the *approximate* correct latitude(s) of the location in degrees and minutes: single figure for a city; two figures for islands or provinces or regions (southernmost and northernmost extent respectively); in the case of extensive territory, to the *nearest whole degree* only.

After the name there follows a listing of the sundials on which it is inscribed, with the latitude figure where there is one (starting from the lowest latitude figure). The Greek or Latin form of the name used in each instance is given. A letter that cannot be read with confidence is marked with an *underdot*; a wholly missing letter is marked [.]. A half-degree in a latitude figure is stated as .5, one-third as .33,

two-thirds as .66 (= 30, 20, 40 minutes respectively). An **asterisk** (*) signifies a figure that *seems likely* to reflect a slip of some kind.

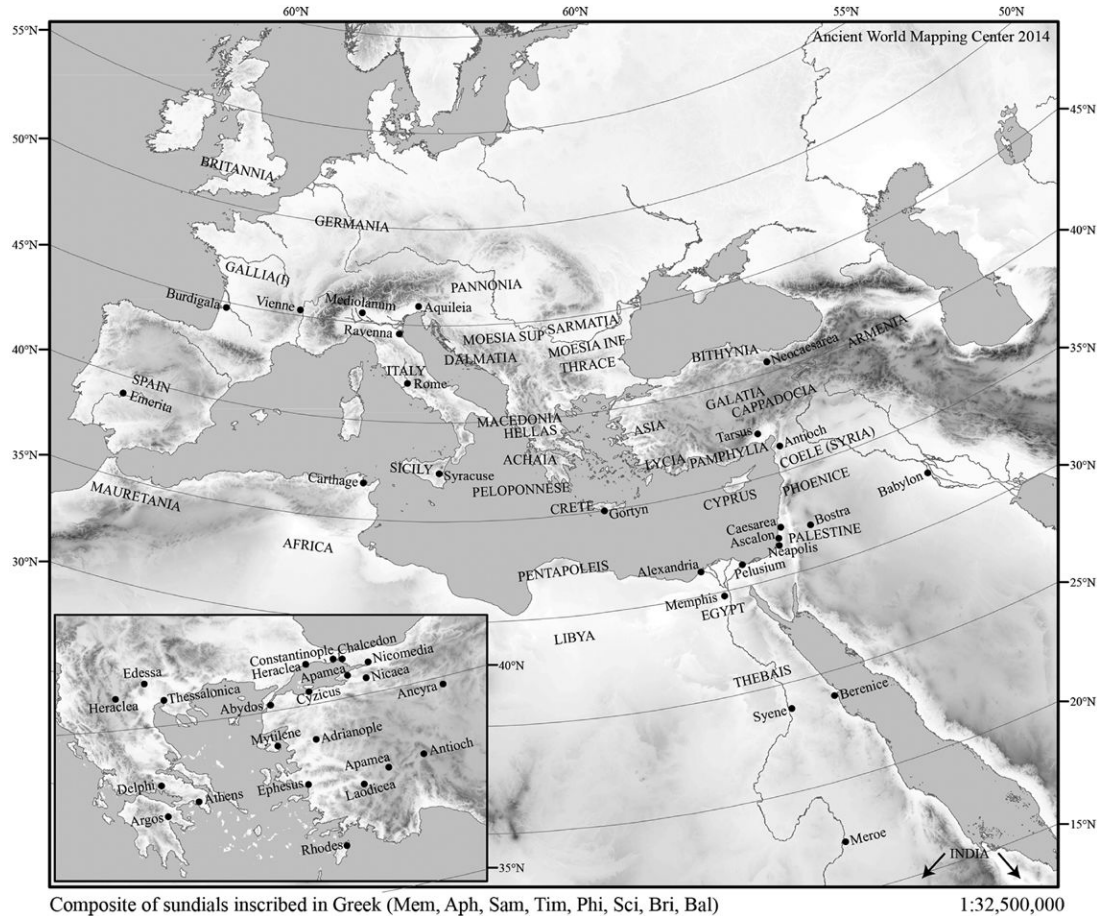
Thereafter the sundials on which the name is inscribed *without* a latitude figure (as on Aqu, Bal, Kir, Wie = nos. 4, 16, 2, 5) are listed in alphabetical order of sundial names.

Last in each instance come, **bolded**, Ptolemy's latitude figure(s) in the *Geography*, with occasional variants, and the form of the name used by Ptolemy (all following Stückelberger, Grasshoff, et al. 2006; see the start of Chapter 2 for an explanation of how Ptolemy states fractions of a degree). Ptolemy consistently renders *Superior* and *Inferior* in Roman province names as ἡ ἄνω and ἡ κάτω respectively.

Each sundial is referred to by the three-letter abbreviation of its name:

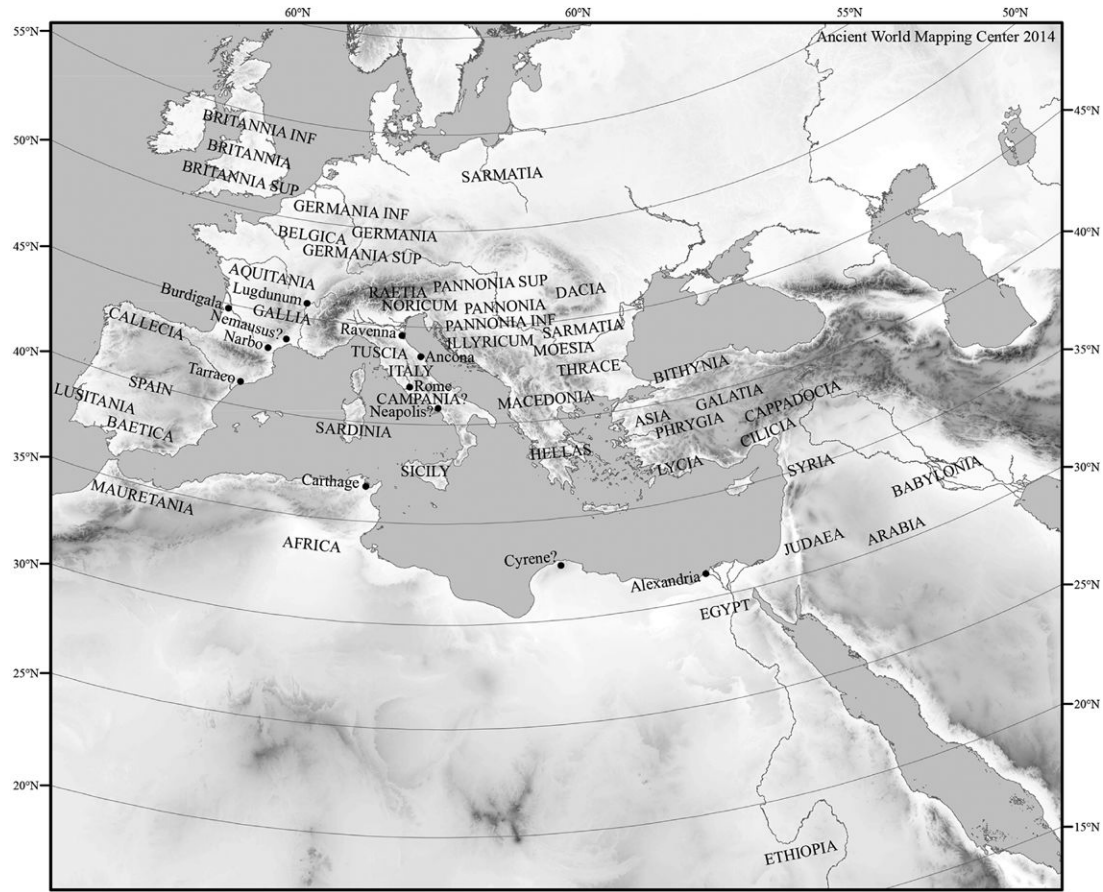
Aph	Aphrodisias, no. 8 (Greek)
Aqu	Aquileia, no. 4 (Latin)
Bal	Balkans, no. 16 (Greek)
Bri	British Museum, London, no. 15 (Greek)
Crê	Crêt-Châtelard, no. 6 (Latin)
Kir	Kircher Museum, no. 2 (Latin)
Mem	Memphis, no. 3 (Greek)
Mér	Mérida, no. 14 (Latin)
Oxf	Museum of the History of Science, Oxford, no. 7 (Latin)
Phi	Philippi, no. 11 (Greek)
Rom	Rome, no. 1 (Latin)
Sam	Samos, no. 9 (Greek)
Sci	Science Museum, London, no. 12 (Greek)
Tim	Time Museum, no. 10 (Greek)
Vig	Vignacourt/Berteaucourt-les-Dames, no. 13 (Latin)
Wie	Kunsthistorisches Museum, Vienna/Wien, no. 5 (Latin)

In addition to the maps for individual sundials in Chapter 2 (Maps 2.1–2.14), **Map G.1** shows the locations on all sundials inscribed in Greek in their approximately correct geographic locations. **Map G.2** does likewise for all sundials inscribed in Latin. **Map G.3** is a composite showing all the locations on Maps G.1 and G.2.



MAP G.I Locations on sundials inscribed in Greek.

Ancient World Mapping Center.

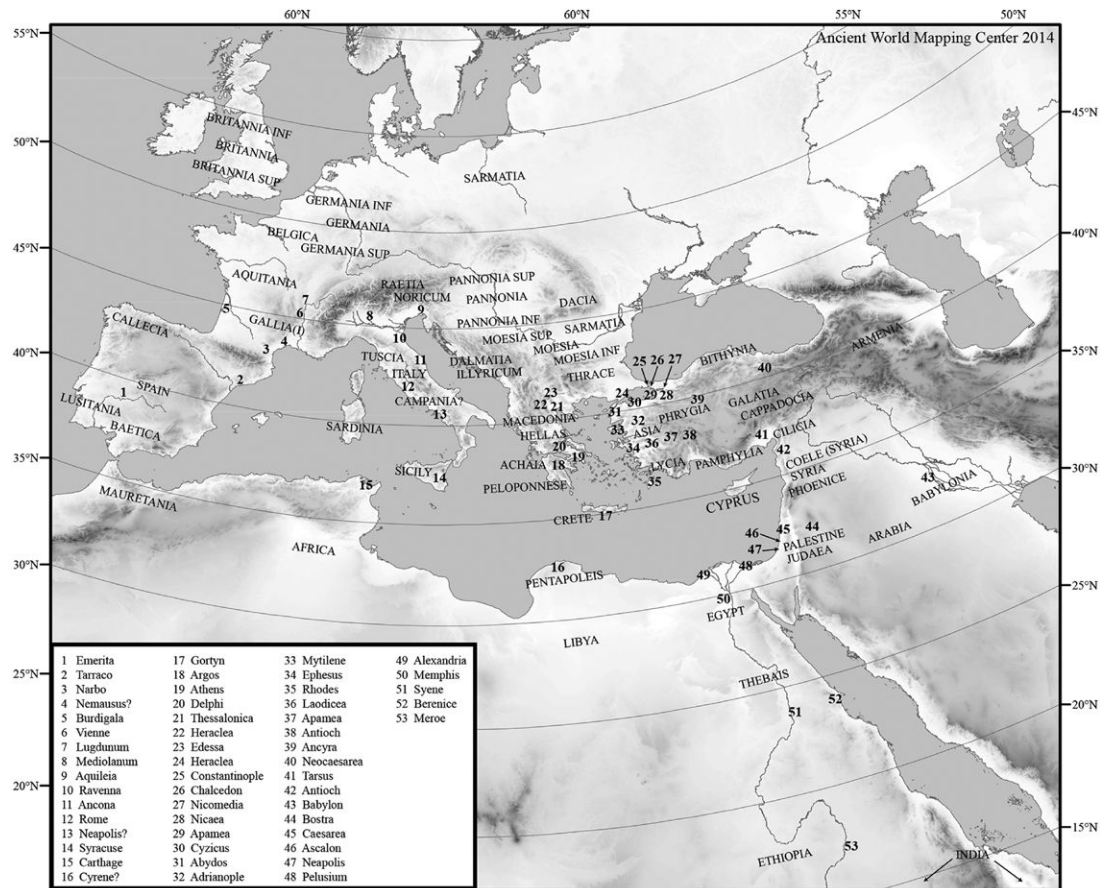


Composite of sundials inscribed in Latin (Rom, Kir, Aqu, Wie, Cr , Oxf, Vig, M r)

1:32,500,000

MAP G.2 Locations on sundials inscribed in Latin.

Ancient World Mapping Center.



MAP G.3 Locations on all sundials covered by Maps G.1 and G.2.

Ancient World Mapping Center.

Latitude figures with no name recoverable

Mem32.5

Mem32.5–33.66

Mem33.66

Tim36 [possibly Coele (Syria)?]

Cities

40 10 Abydos ABYΔQC Bri41 41 15 Ἀβυδος

39 10 Adrianople (Stratonicea? BATlas 56 F3) ΑΔΡΙΑΝΟΥΠΟΛΙΣ Mem39
omitted by Ptolemy

32 55 Ake? see ΔΟΡΑΚΙΝ 33 00 Πτολεμαίς

31 10 Alexandria (Egypt, BATlas 74 B2) ALEXAND Mér30, ALEXAND Vig30,
ΑΛΕΞΑΝΔΡΟΣ Aph31, ΑΛΕΞΑΝΔ Βρι31, ΑΛΕΞΑΝΔΡΙ Mem31, ΑΛΕΞΑΝ
Φι31, ΑΛΕΞΑΝΔΡΟΣ Sci31, ΑΛΕΞΑΝΔΡΕΙΑ Bal, ALEXAN Wie

31 00 Ἀλεξάνδρεια

43 40 Ancona ANCONIS Crê44, ANCON Rom45, ANCONA Wie

43 40 Ἀγκών

39 50 Ancyra ANKYP Sam40.5, ΑΓΚΥΡΑ Mem42 42 00 Ἀγκυρά

36 10 Antioch (Syria? BATlas 67 C4) ANTIOXIA Aph35.33, ANTIOXIA Mem35.5,
ANTIOXIA Sci36 35 30 Ἀντιόχεια38 20 Antioch (Pisidia? BATlas 62 F5) ANTIOXQ Bri39, ANTIOXIA Tim39
39 15 (38 50) Ἀντιόχεια38 00 Apamea (Phrygia? BATlas 65 D1) ΑΠΑΜΙΑ Mem39 (or possibly Bithynian
Apamea is meant; see next entry) 38 55 (39 05) Ἀπάμεια Κιβωτός40 20 Apamea (Bithynia? BATlas 52 D4) ΑΠΑΜ Sam41, possibly Mem39 (see
previous entry) 42 00 (41 55) Ἀπάμεια

45 40 Aquileia ΑΚΥΛΗΙΑ Mem45 45 00 Ἀκουληία

37 40 Argos (Peloponnese? BATlas 58 D2) ΑΡΓΟΣ Mem36.5 36 15 Ἄργος

31 40 Ascalon ΑΣΚΑΛΩΝ Sci30 31 40 Ἀσκαλών

38 00 Athens ΑΘΗΝΑΙ Sci36, ΑΘΗΝΩΝ Aph37, ΑΘΗΝΑΙ Mem37, ΑΘΗΝΑΙ
Bal 37 15 Ἀθῆναι

24 00 Berenice (Egypt? BATlas 80 inset) ΒΕΡΟΝΙΚΗ Mem23.5 23 50 Βερενίκη

32 30 Bostra ΒΟΣΤΡΑ Mem31.5 31 30 Βόστρα

44 50 Burdigala ΒΟΥΡΔΙΓΑΛΑ Aph45, ΒΥΡΔΙΓΑ Wie 45 (30) Βουρδύγαλα

32 30 Caesarea (Palestine? BATlas 69 A4) ΚΕΣΑΡΙΑ Mem32, ΚΕΣΑΡΕΑ Sci32
32 30 Καισάρεια Στράτωνος36 50 Carthage ΚΑΡΧΗΔΩΝ Mem32.66*, ΧΑΡΤΑΓΩΝ Aph33, ÇARTH Wie
32 40 Καρχηδών

41 00 Chalcedon ΧΑΛΚ Sam40.33 43 05 Χαλκηδών

41 00 Constantinople ΚΩΣΤΑ Sam40.33, ΚΩΝΣΤΑΝΤΙΣ Aph41, ΚΩΣΤΑΝΤΙΝΟΣ
Sci41, ΚΩΝΣΤΑ Βρι43, ΚΩΝΣΤΑΤΙΝΟΥΠΙ Mem43, Κ[.]ΝΣΤΑΝΤΙ Tim43

43 05 (Byzantium, BATlas 52 D2)

40 20 Cyzicus ΚΥΖΙΚ Sam40.33, ΚΥΖΙΚΟΥ Aph41 41 30 Κύζικος

- 38 30 Delphi ΔΕΛΦΟΙ Mem37.66 37 40 Δελφοί
ΔΟΡΑΚΙΝ = Dor(a) (ΔΩΡΑ) [and] Ake (ΑΚΗ)? Sci43*
- 32 40 Dor(a)? see previous entry 32 40 Δώρα
- 40 45 Edessa (*Macedonia? BATlas 50 B3*) ΕΔΕΣΑ Mem43 40 20 Ἐδεσσα
- 39 00 Emerita ΗΜΕΡΙΤΑ Aph39.5 39 30 Αὔγουστα Ἡμερίτα
- 38 00 Ephesus ΕΦΕΣΟ Sam (*latitude figure illegible*) 37 40 Ἐφεσος
- 35 00 Gortyn ΓΟΡΤΥΝΑ Mem34.5 34 50 Γόρτυνα
- 41 00 Heraclea (*Lyncestis? BATlas 49 D2*) ΗΡΑΚΛΕΙΑ Mem41.66 (*or possibly the former Perinthus is meant; see next entry*) 40 40 Ἡράκλεια
- 41 00 Heraclea (*former Perinthus, BATlas 52 B3*) Mem41.66 (*or possibly Heraclea Lyncestis is meant; see previous entry*), ΗΡΑΚΛ Sam40.33 (*or possibly Heraclea Pontica is meant; see next entry*) 42 20 Πέρινθος
- 41 20 Heraclea (*Pontica? BATlas 86 B2*) Sam40.33 (*or possibly the former Perinthus is meant; see previous entry*) 43 30 Ἡράκλεια Πόντου
- 37 50 Laodicea (*ad Lycum? BATlas 65 B2*) ΛΑΟΔΙΚ Sam38
38 40 Λαοδίκεια ἐπὶ Λύκῳ
- 38 10 Laodicea (*Katakekaumene? BATlas 63 A4*) Sam38 (*or possibly Laodicea ad Lycum is meant; see previous entry*) 39 40 Λαοδίκεια κατακεκαυμένη
- 45 30 Mediolanum ΜΕΔΙΟΛΑΝ Bri46 44 15 Μεδιολάνιον
- 29 50 Memphis ΜΕΜΦΙΣ Aph29.5, ΜΕΜΦΙΣ Mem30 29 50 Μέμφις
- 17 00 Meroe ΜΕΡΩΗC Bri16, ΜΕΡΩΗC Tim16, ΜΕΡΩΗ Mem16.5*
16 25 Μερὴ
- 39 05 Mytilene? ΜΙΛΙΤ Sam3[.]? 39 40 Μυτιλήνη
- 43 50 NASVMEN (*Nemausus? BATlas 15 C2*) Crê24* 44 30 Νέμαυσος
- 31 30 Neapolis (*Palestine? BATlas 69 B5*) ΝΕΑΠΟΛΙΣ Mem31.66
31 50 Νεάπολις
- 40 50 Neapolis? (*Italy, BATlas 44 F4*) ΝΞ Wie 40 30 (40 55) Νεάπολις
- 40 30 Neocaesarea (*Pontus? BATlas 87 B4*) Ν[.]ΟΚΑΙÇΟ Bri44
41 50 Νεοκαισάρεια
- 40 30 Nicaea ΝΙΚΙΑ Sam40.33 42 15 (41 55) Νίκαια
- 40 45 Nicomedia ΝΙΚΟΜ Sam40, ΝΙΚΟΜΗΔΙΑ Aph42
42 30 Νικομήδεια
- 31 00 Pelusium ΠΕΛΟΥΣΙΟΝ Aph30.5 31 15 Πηλούσιον
- 44 20 Ravenna ΑΡΑΒΕΝΝΑ Mem44, RA Aqu 44 00 Ῥάβεννα
- 41 50 Rome ΡΩΜΗC Bri 41, ΡΩΜΗ Sci41, ΡΩΜΗ Aph41.5, ΡΩΜΗ Mem41.66, ΡΩΜΗC Phi41.66, ROMA Oxf42, ΡΩΜΗC Tim42, RO Aqu, ΡΩΜΗ Bal, ROMA Kir, ΡΟΜ Wie 41 40 Ῥώμη
- 24 00 Syene COHNHC Aph23.5, COHNH Mem23.5, COHNHC Bri24, COHNH Sci24, COHNHC Tim24 23 50 Συήνη
- 37 10 Syracuse CΟΡΑΚΟΥCΑ Mem37 37 (15) Συράκουσαι
- 36 50 Tarsus ΤΑΡCΟΥ Aph36.5, ΤΑΡCΟΥC Bri37, ΤΑΡCΟC Mem38, ΤΑΡCΟΥ Tim38 36 50 Ταρσός

- 40 40 Thessalonica ΘΕCΑΛΟ Bri[40 or 41?], ΘΕCΑΛΟΝΙC Sci40,
 ΘΕCΑΛΟΝΙ Tim40, ΘΕCΑΛΟΝΙΚ Aph43, ΘΕCΑΛΟΝΙΚΗ Mem43
 40 20 Θεσσαλονίκη
 45 30 Vienne ΟΥΙΕΝΝ Phi45 45 00 Ούιεννα

Cities or Islands or Provinces or Regions (*latitudes for the cities only recorded here*)

- 32 40 Babylon(ia) (*Mesopotamia*, BAtlas 91 F5) BABYLON Rom30,
 BABYLONIAE Crê35, ΒΑΒΥΛΩΝ Bal 35 00 Βαβυλών
 32 20 Cyrene? QVIRINE Oxf39 31 20 Κυρήνη
 45 45 Lugdun-um/-ensis LVGD Oxf45, LVGDVN Mér46, LVGDVN Vig46
 45 50 Λούγδουνον
 43 10 Narb-o(n)/-ensis NARB Oxf 43, NARBON Rom43, NARBON Vig43,
 NARBON Mér43.5, NARB Oxf44 43 (15) Ναρβών
 QVIRINE, *see* Cyrene
 36 25 Rhodes ΡΟΔΟΥ Aph36, ΡΟΔΟC Mem36, ΡΟΔΟΥ Phi36, ΡΟΔΟC Sam36,
 ΡΟΔΟC Sci36, ΡΟΔΟC Bal 36 00 Ῥόδος
 41 10 Tarrac-o/-nensis TARRAC Mér 44 40 40 Ταρράκων

Mediterranean Islands or Provinces

- 35–36 Crete ΚΡΗΤΗC Bri34, ΚΡΗΤΗC Aph35 34 00–35 30 Κρήτη
 34 40–35 40 Cyprus ΚΥΠΡΟΥ Aph34, ΚΥΠΡΟΥ Bri35, ΚΥΠΡΟΥ Tim35
 34 40–36 10 Κύπρος
 39–41 Sardinia SARDIN Oxf40 35 30–39 30 Σαρδών(ν)
 36 40–38 20 Sicily CΙΚΕΛΙΑC Tim35, CΙΚΕΛ[.]Α Bri36, CΗΚΕΛΙΑ Sci36,
 CΙΚΕΛΙΑC Aph38, SICILI Oxf41, CΙΚΕΛΙΑ Bal 36 00–38 30 Σικελία

Provinces or Regions

- 36–40 Achaia (*province?*) ΑΧΑΕΙΑC Bri37 34 20–38 30 Ἀχαία (*see*
also Hellas, Peloponnese)
 south–37 Africa (*province*) ΑΦΡΙΚΗ Sci31, ΑΦΡΙΚΗC Tim32, ΑΦΡΙΚΗ Bri34,
 ΑΦΡΙCΕ Rom40, ΑFRICAΕ Vig40, ΑFRCA Oxf41, ΑFRICAΕ Crê42, ΑFRICA
 Wie 25 00–33 20 Ἀφρική
 43–47 Aquitania ΑQVITAN Mér45, ΑQVITAN Vig45
 43 00–48 30 Ἀκουιτανία
 28–33 Arabia (*province*) ΑRABIAΕ Crê29, ΑRABIA Rom29
 28 30–31 40 Ἀραβία
 38–41 Armenia ΑΡΜΕΝ[.]Α Bri44, [.]ΡΜΕΝΙΑC Tim44
 38 00–44 30 Ἀρμενία
 36–40 Asia (*province*) ΑSIAΕ Oxf31, ΑSIAΕ Vig33, ΑCΙΑ Mem40, ΑCΙΑ Bri43,
 ΑCΙΑ Bal, ΑSIA Wie 35 30–41 30 Ἀσία
 36–38 Baetica ΒΕΤΙCΑ Mér38 36 00–39 00 Βαιτική

- 47–52 Belgica BELGI Mér48, BELG Oxf48, BELGIC Vig48
 45 10–54 00 Βελγική
- 40–42 Bithynia (*with Pontus, province*) BITVNI Oxf35, ΒΙΘΥΝΙΑ Bri41, BITHYNIAE Crê41, BITHYNI Rom41, [...]ΘΥΝΙΑC Tim44
 41 15–43 30 Βιθυνία
- 50–59 Britannia (Britain) (*entire island north to Hadrian's Wall area*) ΒΡΕΤΤΑΝ Bri50[+?], BRIT Oxf55, BRITANN Vig55, BRITANNIAE Crê56, BRITAN Rom57, BRITT Wie 51 30–59 00 Ἀλουίων νῆσος Βρεττανική
- 53(?)–55 Britannia Inferior (*northern province to Hadrian's Wall area*) BRITANN INF Mér57 55 30 (?)–59 00
- 50–53(?) [Britannia?] Superior (*southern province*) SVPERIOR Mér54 51 30–55 30 (?)
- 41–44 Callecia (= *Callaecia/Gallaecia? region, later province*) CALLECIA Vig44 41 50–46 00 (Καλλαικοὶ Βρακαριοὶ and Καλλαικοὶ Λουκηνσιοὶ)
- 40 40–41 30 Campania? CAMPA Wie 40 30–41 40 (Καμπανοί)
- 38–41 Cappadocia CAPPAD Oxf31*, CAPPAD Vig34, ΚΑΠΠΑΔΟΚΙΑ Aph39.5, ΚΑΠΠΑΔ Bri43, ΚΑΠΠΑΔΟΚΙ Tim43 37 30–43 00 Καππαδοκία
- 36–37 Cilicia CILICIA Oxf31 36 20–37 40 Κιλικία
- 35–37 Coele (*Syria; region, later province*) ΚΟΥΛΗC Bri36 (*possibly also* Tim36) 34 30–38 00 Κοίλη (Συρία)
- 44–47 Dacia DACIA Mér47, DACIAE Vig51, DACIA Oxf52 43 30–48 30 Δακία
- 42–45 Dalmatia (*province*) ΔΑΛΜΑΤ Bri42, ΔΕΛΜΑΤΙΑ Sci42, ΔΑΛΜΑΤΙΑC Tim42 41 00–45 00 Δαλματία
- 24–31 Egypt AEGYPT Oxf30, ΑΙΓΥΠΤΟΥ Bri31, [...]ΓΥΠΤΟΥ Tim31, AEGYPTI Crê33, AEGYPTI Rom33, AEGYP Wie 23 50–31 20 Αἴγυπτος
- south–24 Ethiopia AETHIOPIAE Crê30, ΑΕΤΙΟΠΙ Rom30
 south–23 50 Αἰθιοπία
 GAL Oxf48 *see* Gallia
- 38–42 Galatia ΓΑΛΑΤΙΑC Tim40, [...]ΑΛΑΤΙΑ Aph42, GALATI Oxf45 38 40–44 30 Γαλατία
- 43–51 Gallia (Gaul) ΓΑΛΛΙΑC Tim42, ΓΑΛΛΙΑC Bri43, ΓΑΛΛΙΑΙ Mem44, ΓΑΛΛΙΩΝ Aph46, GALLIAE Crê48, GAL Oxf48, GALLIAE Rom48, ΓΑΛΛΙΑ Wie 42 10–53 30 Γαλλία
- 47–54 Germania (Germany) (*to Elbe mouth?*) GERMANIAE Crê50, GERMAN Mér50, GERMA Rom50, GERMAN Vig50, ΓΕΡΜΑΝΙΑC Tim50[+?], GERMAN Wie (*for the likelihood that GER 51 was originally inscribed on Oxf, see its description at Chapter 2 no. 7*) 45 30–56 00 Γερμανία
- 50–52 Germania Inferior GERI Oxf51 50 00–54 00
- 47–50 Germania Superior GERS Oxf49 45 30–50 00
- 36–41 Hellas (= *Aegean region?*) ΕΛ[...]ΑΔΟC Tim37, HELLADE Wie 34 00–41 30 Ἑλλάς (*see also* Achaia, Peloponnese)
 Hispania, *see* Spain

- 41–46 Illyricum ILLYRICI Crê37, ILLYRI Rom37, ILLYRICI Vig46
 41 00–45 00 Ἰλλυρίς
 8–north India (*subcontinent? or anywhere far to the south or east of the Roman empire?*) INDIA Mem8 11 00–north Ἰνδική
 38–46 Italy ITALIAE Crê42, ILATIA Mér42, ITAL Oxf42, ITALIAE Rom42, ITALIAIC Tim42, ITALIAE Vig42, ΙΤΑΛΙΑC Bri43, ITAL Oxf43
 38 00–45 00 Ἰταλία
 31–33 Judaea IVDEAE Vig35 30 40–32 30 Ἰουδαία (*see also* Palestine)
 south–25 Libya (*south of the Roman provinces Mauretania and Africa?*)
 ΛΙΒΥHC Bri24, LIBYH Bal south–25 00 Λιβύη
 37–41 Lusitania LVSITAN Mér42 37 50–41 50 Λουσιτανία
 36–37 Lycia LYCIAE Oxf31, LYKIAIC Aph35.33 35 50–37 40 Λυκία
 39–42 Macedonia MACEDO Oxf40, ΜΑΚΕΔΟΝΙΑ Tim40
 38 30–42 00 Μακεδονία
 south–36 Mauretania MAVRE Rom30, MAYPITANIA Tim34, MAVRT Oxf40*,
 MAVRETAN Crê40.5, MAVRETA Vig41 25 00–36 00 Μαυριτανία
 42–46 Moesia MOESIA Mér43, MOESIAE Vig51 42 00–48 30 Μυσία
 44–46 Moesia Inferior MYCIAKA Bal 43 00–48 30
 42–44 Moesia Superior MYCIAANΩ Bal 42 00–44 40
 46–48 Noricum NORICI Vig46, NORICV Mér47 45 20–47 00 Νωρικόν
 31–33 Palestine ΠΑΛΑΙCΤ Bri32, ΠΑΛΑΙCΤIN Tim32, ΠΑΛΕCΤINΗ Aph36,
 ΠΑΛΕCΤINΗ Sci38* 30 40–32 30 Παλαιστίνη (*see also* Judaea)
 37–38 Pamphylia ΠΑΜΦΥΛ Bri36, ΠΑΜΦΥΛΙΑ Mem36, ΠΑΜΦΥΛΙΑ Aph36.5,
 ΠΑΝ[.]ΥΛΙΑC Tim37 36 30–38 30 Παμφυλία
 45–48 Pannonia Π[.]NNONIAC Tim44?, ΠANNONI Bri45, PANONI Oxf46,
 PANNON Vig49 44 30–48 00 Παννονία
 45–48 Pannonia Inferior PANN I Mér45 44 30–48 00
 45–48 Pannonia Superior PANN S Mér45.5 45 20–47 40
 36 20–38 20 Peloponnese ΠΕΛ[.]ΠΟ Bri39 or 40 or 41?
 34 20–37 00 Πελοπόννησος (*see also* Achaia, Hellas)
 32–33 Pentapol-is/-eis ΠΕΝΤΑΠΟΛIC Mem31, [..]ΝΤΑΠΟΛC Tim31,
 ΠΕΝΤΑΠΟΛΕC Aph32, ΠΕΝΤΑΠ Bri32 31 00–31 40 Πεντάπολις
 33–35 Phoenice (*Syria; region, later province*) ΦΟΙΝΙΚHC Aph33.33
 32 30–34 30 Φοινίκη
 38–40 Phrygia PHRYGI Oxf36 38 00–41 20 Φρυγία
 46–49 Raetia RETIA Mér46, RETIAE Vig46 45 20–47 20 Ραιτία
 47–north Sarmat(ia) SARMAT Mér43.5, CΑ[.]M[...].A Bri45, SARMATIA Vig53
 48 30–north Σαρματία
 36–44 Spain HISPANIAE Crê35, CΠΑΝΙΑC Tim37, CΠΑΝΙΑC Bri38, HISPAN
 Rom40, CΠΑΝΙΑC Aph42, ISPAN Oxf42, S[.]ΑΝΙΑE Vig42, HISPANΙΑ Wie
 36 00–46 00 Ἰσπανία
 SVPERIOR Mér54 *see* [Britannia?] Superior

- 32–37 Syria INSVRIA Oxf₃6, SYRIA_E Vig₃7, SYRIA_E Crê₃8, SYRIA_E Rom₃8, CYPIA Bal 31 00–38 00 Συρία (*see also* Coele, Phoenice)
- 24–28 Thebais ΘΗΒΑΤΑ Bri₂4, ΘΗΒΑΙC Sci₂8, ΘΗΒΑΙΔOC Tim₂8 23 50–28 00 Θηβαίς
- 40–43 Thrace ΘΡΑΚHC Bri₄1, ΘΡΑΚH Mem₄1*, TRACIA Oxf₄1, ΘΡΑΚHC Tim₄1, ΘΡΑΚH Bal 40 40–44 40 Θράκη
- 42–44 Tuscia (*region, later province*) TVSCIA Wie 41 40–42 40 (Τοῦσκοι)

Table of Latitudes and Locations

An asterisk (*) following a name signifies that the latitude figure for the name *seems likely* to reflect a slip of some kind. Names on sundials nos. 2, 4, 5, and 16 are not to be found in the table because no latitude figures are associated with them.

[illegible]

[illegible]

[illegible]

[illegible]

(Continued)

	Latitude	Rom I	Mém 3	Cré 6	Oxf 7	Aph 8	Sam 9	Tim 10	Phi II	Sci 12	Vig 13	Mér 14	Bri 15
43		Narbo	Constantinople		Italy			Constantinople			Narbo	Moesia	Cappadocia Italy Constantinople Gallia Asia
43-5			Thessalonica Edessa			Thessalonica		Cappadocia		Dorakin*		Sarmat(ia) Narbo	
44			Galliai Ravenna					Armenia					Neocaesarea Armenia
				Ancona	Narbo			Pannonia Bithynia			Callecia	Tarraco	
45			Aquileia			Burdigala							Sarmatia Pannonia
45-5		Ancona			Lugdunum Galatia				Vienne		Aquitania	Aquitania Pannonia Inf	Pannonia Sup

46	Gallia		Mediolanum	
			Lugdunum	Lugdunum
			Noricum	Noricum
			Raetia	Raetia
			Illyricum	
47		Pannonia		
48				
	Gallia	Gallia		
		Gallia Belgica		
49		Germania Sup		
50	Germania	Germania	Germania	Germania
50[+?]				
51				
			Moesia Dacia	Britannia
52				
53		Germania Inf Dacia		
54			Sarmatia	[Britannia?] Sup
55				
56		Britannia	Britannia	
57	Britannia			Britannia Inf
illegible				
			Ephesus	

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Index

- Abbreviation. *See* names
- Accuracy of sundials. *See* time-telling
- Adamclisi (Romania), names on
monument, 112
- Ake, 87
- Amiens (France). *See* Samarobriva
- Ammianus Marcellinus, 165
- Ancona (Italy), 147–48
- Ancyra, 68
- “Anglo-Saxon” world map, 127–29
- Antioch, identification from latitude
figures, 124
- Antoninus Pius, coin portraying, 36–37, 47
- Apamea, identification from latitude
figures, 124–25
- Aphrodisias, fixed sundial, 5–6
- Aphrodisias sundial (no. 8), 60–64
accuracy of latitude figures, 133
choice of names, 160, 163
name-forms, 113
relationship of names, 133
See also fractions
- Apulum, 140
- Aquileia sundial (no. 4), 35–36
- Aquincum Fragment, 143, 149, 154, 159,
191–201
dating, 201
maker, 140, 201
- Army (Roman), concern with time, 140
- Artemidorus on sundials, 163–64
- Ascalon, 132
- Asia Minor, accuracy of latitudes for
names in, 59, 131–32
- Asterix, 70
- Astrolabes, 30, 173–77
- Astrology, 167
- Atwood, Seth, 171
- Augustodunum, 158
- Augustus, 164
- Aurelius Gaius, 161–63
- Avien(i)us, 133
- Awareness, geographical, 126, 130–32,
150, 157–59, 201. *See also*
worldview
- Babylonia, 159
- Baldini, Gianfrancesco, 24–25
- Balkans sundial (no. 16), 104–9
choice of names, 149–50
design, 154
- Belgica, 122, 130
- Berenice, 124, 151
- Berteaucourt-les-Dames. *See* Vignacourt
- Bone, used for sundials, 10, 139
- British Museum, London, sundial (no. 15),
99–103

- British Museum,..... (*continued*)
 names and latitude figures compared
 with Time Museum (no. 10),
 144–46, 168
 numerals, 194
- Caesarea, identification from latitude
 figures, 124
- Calendars, ancient (especially
 Alexandrian and Julian), 4–5, 16, 30,
 167–68
- Callecia, 114
- Canterbury (UK), 177
- Cantray (UK), 184–85
- Cappadocia, single latitude figure for, 121,
 131–32, 142, 146
- Case-forms. *See* names on portable
 sundials
- Catania, 143
- “Chilinder” sundials. *See* cylinder
- Christians as sundial users, 166–67
- Cities, (fixed) sundials in, 5–6, 143
- City-names on portable sundials, 113, 168
 choice of compared to provinces,
 149–50
 homonymous, 124–26
- Clepsydra*, 5, 8
- Commodus, coin portraying, 27–28
 imaginary vehicle of, 153
- Compactness of portable sundials, 77,
 141–42, 153
- Constantinople, latitude figures
 for, 69, 121
 named on portable sundials, 116,
 149, 168
- Cost of portable sundials.
See manufacture
- “Cotton” world map. *See* “Anglo-Saxon”
- Crêt-Châtelard sundial (no. 6), 48–52
 accuracy of latitude figures, 132
 names, 147
 numerals, 23, 194
- Cylinder/“pillar” sundials, ancient, 10–13,
 137–39, 165
 medieval onward, 171–73, 177
- Cyrene, 57–59
- Dating of geographical portable sundials,
 149, 168. *See also* individual entries
 in Chapter 2
- Declination of the sun, 16, 192, 198
- Design of portable sundials, 8, 139–40,
 200–201
 ingenuity, 77, 84–85, 90, 93, 104–5,
 153–55
- Dionysius Periegetes, 133
- Doclea, 87
- Dor(a), 87
- Dorakin, 87
- Durand, Vincent, 48–51
- Edessa, identification from latitude
 figures, 125–26
- Egypt, single latitude figure for, 121, 142
- Empire (Roman), source of pride, 157–59,
 168, 201
 spanned by names on portable
 sundials, 148–49
See also provinces
- Encyclopedic knowledge, taste
 for, 157–58
- Epitaphs recording hours, 166–67
- Equinox, 16, 117–18
- Eratosthenes, 117
- Este (Italy), 10–11
- Ethiopia, 151, 159
- Evans, Lewis, 52
- Findspots of portable sundials, 137–39
- Forbach (France), 13–14
- Fractions of a degree in latitude figures,
 on portable sundials, 22–23, 31,
 68–70, 144
 in Ptolemy, *Geography*, 21
- Gadgetry, appeal to Romans, 153–55
- Galliae, 116
- Genethliology, 167
- Geography in Roman schools, 156, 158–59
- Globes, pocket (early modern), 141
- Gnomon* (shadow caster), 8, 11, 15, 17,
 117–18, 153
- Gromaticus*, 191–92

- Hadrian's Wall, 161, 199
Heilbronner, Raoul, 52
Hellespont, 113, 174–75
Heraclea, identification from latitude
 figures, 124–25, 134
Herculaneum, sundials found at, 120
Hipparchus, 118
Holbein the Younger, Hans, 172
Horarium/horologium, 5
Horologiarius, 140
Horoscopes, 167
Hours, equinoctial and seasonal, 8–9,
 118, 164
 in epitaphs, 166–67
 on portable sundials, 17
Hyginus Gromaticus on the surveyor's
 profession, 166
- "Ilam Pan," 161
Illyricum, 114
India, 150–51, 158–59, 163
Inferior, subdivision of Roman
 provinces, 114
Italy, single latitude figure for, 121, 142
Itineraries, 159–61
- Jerusalem, 166
Jokes about attention to sundials, 164–65
Judaea, 149
- Kenner, Friedrich, 35–36
Kircher Museum, Rome, sundial (no. 2),
 27–29
Krabbe, Johannes, 180–81
Kunsthistorisches Museum, Vienna/
 Wien, sundial (no. 5), 36–48,
 173, 175
 names, 148
- Laodicea, identification from latitude
 figures, 68, 124, 134
Latitude, concept, 116–20
 concern for on portable sundials,
 143–46
 figures on portable sundials, 18,
 119–23, 152
- fractions of a degree, 21, 68–70, 144,
 166
fundamental for sundials' operation,
 8, 15, 126, 141
intervals marked on portable sundials,
 15–16, 143
means to distinguish homonymous
 cities, 123–26
organizing principle for names on
 portable sundials, 122–23, 130
possible means to establish, 154–55
 See also Chapter 5
Layout of figures and names on portable
 sundials, 129
Libya, 105, 114, 151
Libraries as venues for sharing
 knowledge, 156–57
Longitude, 23, 111, 118–20, 131, 175
- Manufacture of portable sundials,
 139–40, 147–48, 168, 200–201
Maps, 126–29, 158
 relationship with portable sundials,
 136, 168
Marinus, 118–19, 131
Mediolanum, 149
Mementos, portable sundials as, 160,
 169, 190
Memphis sundial (no. 3), 29–34
 choice of names, 149–51, 160
 homonymous names, 124–25
 India on, 150–51
 See also fractions
Mérida sundial (no. 14), 93–99
 choice of names, 149–50
 ingenious design, 93, 154–55
 order of names, 122, 129
Meroe, 159
Miletus, 68–69
Months, 15, 17, 30. *See also* calendars
Mosaics, choice of geographical names, 150
Müller, Johannes ("Regiomontanus"),
 180–81
Museum of the History of Science,
 Oxford, sundial (no. 7), 15–17,
 52–59

- Museum of the History..... (*continued*)
 accuracy of latitude figures, 59,
 131–32, 168
 choice of names, 151–52
 form of letter A, 54–55, 160
 memento of travel, 160, 190
 name-forms, 112–13
 original reverse, 54–56
 Mytilene, 68–69
- Names on portable sundials, 15, 18, 111–16
 abbreviation, 112
 absence of distinctive Tetrarchic forms,
 116, 163, 168
 case-forms, 112–13
 choice, 87, 147–52
 clusters, 149–50
 copying, 168
 Greek choices compared with Latin,
 144, 148–49
 homonymous, 124–26
 limitation to regions or cities,
 113–16, 126
 relationships inferred from order, 130,
 133–35
 sequences, 130–31
 spelling mistakes, 87, 112
See also Provinces
- Nas̄tūlus, 176–77
Navicula sundials, 177–79
 Neapolis, identification from latitude
 figures, 124
 in Italy (modern Naples), 147
 Neocaesarea, 150
 identification from latitude figures,
 123–24
 Nicomedia, 69
 Numerals on portable sundials, 22–23, 31,
 51, 57, 62, 68–70, 87
 Nuremberg sundials, 139, 143, 181–84
- Oculist, user of cylinder/“pillar” sundial,
 10, 137–39, 165
 Operation of portable sundials, 14–17
 Orientation inferred from portable
 sundials, 129
- Oxford sundial. *See* Museum of the
 History of Science
- Peoples, names absent from portable
 sundials, 113
 Pepys, Samuel, 153, 189
Periegesis, 133, 160–61
 Perinthus. *See* Heraclea
Periodos/Periplous. *See* *Periegesis*
 Peutinger Map, 126–27, 158–59
 Philippi sundial (no. 11), 76–81
 choice of names, 148
 ingenious design of, 77, 153
 latitude figures, 120, 122, 142–43, 175
 name-forms, 112
 Physical feature-names, absent from
 portable sundials, 113, 126
 Pillbox sundials, 13–14, 141, 149, 153–54,
 175. *See also* Aquileia sundial;
 Kircher Museum; Kunsthistorisches
 Museum
- Pliny the Elder, encyclopedist, 157
 on latitude as fundamental for
 sundials, 116–17
 on length of daylight, 118
 Pompeii, sundials found at, 120, 165
 Pride in Roman empire, 157–59, 168, 201
 Priscian, 133
 Private objects, portable sundials as, 112,
 125, 130, 136, 148–52, 160, 168
 Provinces (Roman) on portable sundials,
 choice of compared to cities, 149–50
 clues for dating, 59, 87, 99, 109
 means of articulating spatial
 awareness, 126–29
 names, 113–16
 single latitude figures, 21, 120–22,
 142, 168
 See also empire
- Ptolemy, *Almagest*, 119, 199
 Ptolemy, *Geography*, coordinates, 21, 111,
 119–20
 distinguishes homonymous cities, 123
 impact, 119, 156, 168
 latitude figures compared with those
 on sundials, 120–25

- range of names, 113
- use of nominative, 112
- See also* astrolabes; Nuremberg sundials
- Ptolemy, *Table of Important Cities*, 119
- Puteoli, fixed sundial, 5–7
 - glass flask depicting, 6–7, 160
 - removal of corpses, 164
- Pyrenees, 172
- Reflectance transformation imaging (RTI), 20–21, 36, 100, 192, 195
- “Regiomontanus” sundials, 179–81
- Region-names on portable sundials, 150–52
 - indistinguishable from provinces, 114–16
 - See also* provinces
- Reinmann, Paul, 182–83
- Rhodes, 159, 191, 197–99
- Rome, fixed sundial, 143
 - length of daylight, 8–9
 - named on portable sundials, 149
 - See also* empire; pride; provinces
- Rome sundial (no. 1), 24–27
 - accuracy of latitude figures, 132
 - names, 147
- Samarobriva, 11–13, 88, 139
- Samos sundial (no. 9), 65–70
 - accuracy of latitude figures, 134
 - choice of names, 150
 - fractions, 22–23
 - homonymous names, 124–25
 - relationship of names, 133–34
- Sarmatia, 91, 113, 151, 163
- Science Museum, London, sundial (no. 12), 82–87, 155, 157
 - accuracy of latitude figures, 132
- Scottish stone sundials, 184–85
- Seneca on attention to time, 164
- Shadow caster. *See* gnomon
- “Shepherd’s watch,” 172
- Sibton Abbey (UK), 178–79
- Solarium*, 5–7
- [de Solla] Price, Derek, 36, 38
- Solstice, 9, 16, 117
- Spelling mistakes. *See* names on portable sundials
- Stade, 117
- Stereographic projection, 38, 173
- Sundials, order of presentation, 19–20
 - influence after antiquity, 171–73
 - See* individual entries in Chapter 2
 - See also* Aquincum; bone; cities; compactness; cylinder/“pillar”; dating; design; findspots; jokes; manufacture; maps; mementos; names on portable; *navicula*; Nuremberg; operation; private objects; “Regiomontanus”; Scottish; “Sunwatch”; terms; time-telling accuracy; tolerance of inaccurate time-telling; types; uses; Vitruvius; wood
 - “Sunwatch,” 186–88
- Superior*, subdivision of Roman provinces, 114
- Surveyors as sundial users, 70–71, 165–66, 191–92
- Syene, 159, 191, 197–99
- Terms for sundials, 5
- Tetrarchs, military campaigns, 161
 - re-organization of Roman provincial administration, 114–16, 163, 168
- Thessalonica, latitude figures for, 22–23, 62, 121, 146
- Thule, 194
- Time, ancient concern with, 4–5, 163–67
 - Roman army’s concern, 140
- Time-telling accuracy (portable sundials), 141–43
- Time Museum, Rockford, Illinois, 171
- Time Museum sundial (no. 10), 70–75
 - names and latitude figures compared with British Museum (no. 15), 144–46, 168
 - punch mark, 72, 154, 194
 - use by surveyor, 165–66
- Tischendorf, Constantin von, 30–33
- Tolerance of inaccurate time-telling, 142–43, 152, 168

- Travel, freedom to, 159–60
- “Traveler’s” sundial. *See* cylinder
- Trimalchio imagined as portable sundial user, 169–70
- Types of portable sundial, 9–10
- Uses for/users of portable sundials, 139, 165–69, 200–201
- Vicarelo cups, 142
- Vienna sundial. *See* Kunsthistorisches Museum
- Vignacourt/Berteaucourt-les-Dames sundial (no. 13), 88–92
- accuracy of latitude figures, 131
- ingenious design, 90, 154–55
- order of names, 122, 130
- preference for naming provinces, 149–50
- Vitruvius on portable sundials, 9, 117–18, 120, 137
- Wien sundial. *See* Kunsthistorisches Museum
- Wood, used for sundials, 139, 182
- Worldview reflected by sundials, 3–4, 126–36, 158–59, 168.
See also empire